

TECHNICAL PROGRESS REPORT

For the period:

January 1, 1992, through December 31, 1992

Prepared for:

Rosebud SynCoal Partnership
Advanced Coal Conversion Process Demonstration
Colstrip, Montana

DOE Contract
DE-FC22-90PC89664

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December 1993

For submittal to:

United States Department of Energy
Pittsburgh Energy Technology Center

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1.0 INTRODUCTION AND PURPOSE

This report contains a description of the technical progress made on the Advanced Coal Conversion Process (ACCP) Demonstration Project from January 1, 1992, through December 31, 1992.

The ACCP Demonstration Project is a U.S. Department of Energy (DOE) Clean Coal Technology Project. The Cooperative Agreement defining this project is between DOE and the Rosebud SynCoal Partnership. In brief, Western Energy Company, which is a coal mining subsidiary of Entech, Inc., Montana Power Company's (MPC's) non-utility group in Colstrip, Montana, was the original proposer for the ACCP Demonstration Project and Cooperative Agreement participant. To further develop the ACCP technology, Entech created Western SynCoal Company. After the formation of the Rosebud SynCoal Partnership, Western Energy Company formally novated the Cooperative Agreement to the Rosebud SynCoal Partnership to facilitate continued participation in the Cooperative Agreement. The Rosebud SynCoal Partnership is a partnership between Western SynCoal Company and Scoria, Inc., a subsidiary of NRG Energy, Inc., Northern States Power's non-utility group.

This project demonstrates an advanced thermal coal drying process, coupled with physical cleaning techniques, that is designed to upgrade high-moisture, low-rank coals to a high-quality, low-sulfur fuel, registered as the SynCoal® process. The coal is processed through three stages (two heating stages followed by an inert cooling stage) of vibrating fluidized bed reactors that remove chemically bound water, carboxyl groups, and volatile sulfur compounds. After drying, the coal is put through a deep-bed stratifier cleaning process to separate the pyrite-rich ash from the coal.

The SynCoal® process enhances low-rank, western coals, usually with a moisture content of 25 to 55 percent, sulfur content of 0.5 to 1.5 percent, and heating value of 5,500 to 9,000 British thermal units per pound (Btu/lb), by producing a stable, upgraded, coal product with a moisture content as low as 1 percent, sulfur content as low as 0.3 percent, and heating value up to 12,000 Btu/lb.

The 45-ton-per-hour unit is located adjacent to a unit train loadout facility at Western Energy Company's Rosebud coal mine near Colstrip, Montana. The demonstration plant is sized at about one-tenth the projected throughput of a multiple processing train commercial facility. The demonstration drying and cooling equipment is currently near commercial size.

2.0 PROJECT PROGRESS

2.1 SIGNIFICANT ACCOMPLISHMENTS

Rosebud SynCoal Partnership's ACCP Demonstration Facility entered Phase III, Demonstration Operation, in April 1992 and has been operating in an extended startup mode since that time. As with any new developing technology, a number of unforeseen obstacles have been encountered; however, Rosebud SynCoal Partnership has instituted an aggressive program to overcome these obstacles. Significant accomplishments in the history of the SynCoal® process development are shown in Appendix A. Table 2.1 lists the significant accomplishments for 1992.

Table 2.1. Significant Accomplishments for 1992

Period	Significant Accomplishments
January 1992	<ul style="list-style-type: none"> Over 70 percent of the ACCP Demonstration Plant equipment was initially tested and operated. Conducted Cold Air Flow Testing in First Stage and Cooler Systems. Successfully modified vibrating reactor beds to correct for excessive deflection during coast down. Removed rotors from second-stage recirculation fan and shipped to Salt Lake City fabricator for rebuilding of rotor shafts.
February 1992	<ul style="list-style-type: none"> Solved vibration problems on 1st and 2nd stage fans. Successfully operated 90 percent of the ACCP Demonstration Plant equipment. Fixed hardware problems on Plant Control System. Completed initial refractory lining cure in the process gas furnace.
March 1992	<ul style="list-style-type: none"> Initiated dry coal production on March 23, 1992. Completed first 24-hour run on March 29, 1992. Successfully operated 98 percent of the ACCP Demonstration Plant equipment. Fixed hardware problems on Plant Control System. Completed final furnace refractory cure.
April 1992	<ul style="list-style-type: none"> Demonstrated coal flow at 30-40 tons per hour. Successfully operated all ACCP Demonstration Plant equipment. Uncleaned SynCoal® product analyzed as 1.9 percent moisture and 11,370 Btu/lb. Identified problems with explosion panels, rotary airlocks, drag conveyors, and coal fines in cooling tower water.
May 1992	<ul style="list-style-type: none"> Produced 960 tons of cleaned SynCoal® product and sent to product silo - 3-5 percent moisture, 9 percent ash, 0.5 percent, and 11,500 + Btu/lb. Identified spontaneous heating problem with the SynCoal® product. Completed first continuous 24-hour clean SynCoal® production run on May 28, 1992.
June 1992	<ul style="list-style-type: none"> Successfully operated all ACCP Demonstration Plant equipment. Produced 670 tons of clean product during 95 hours of operation in three separate test runs. Shipped 214 tons of SynCoal® to MPC's J.E. Corette Plant by rail on June 17, 1992. Official dedication of the ACCP Demonstration Project on June 25, 1992. Identified problem with dustiness of SynCoal® product. Identified need for an alternate fines disposal system.

Table 2.1. Significant Accomplishments for 1992 (cont'd.)

July 1992	<ul style="list-style-type: none"> • Successfully executed process tests D9201 and D9202. • Initiated pilot plant testing to assist with spontaneous combustion issue. • Installed process fines slurry disposal system.
August 1992	<ul style="list-style-type: none"> • Initiated truck deliveries to Colstrip Units 3 and 4. • Continued pilot plant testing. • Provided a full week of operator training to all operators. • Continued process testing, conducting test D9203.
September 1992	<ul style="list-style-type: none"> • Identified internal process gas bypass problem in dryer reactors. • Continued process testing, conducting tests D9204, D9205, and D9206. • Shipped 1,672 tons of SynCoal® to MPC's J.E. Corette Plant. • Successfully operated the process furnace below 2 percent excess oxygen.
October 1992	<ul style="list-style-type: none"> • Completed 81 hour continuous coal run 10/2/92. • Completed winterization outage. • Trucked 329 tons of SynCoal® to MPC's J.E. Corette Plant. • Trucked 194 tons of SynCoal® to Colstrip Units 3 and 4. • Discovered dryer/cooler reactor bearing factory flaws. • Installed bin inerting system on T894. • Repaired/replaced main process heat exchanger expansion joint and process gas fan shaft seals. • Drilled out cooler reactor plenum holes.
November 1992	<ul style="list-style-type: none"> • Trucked 929 tons of SynCoal® to MPC's J.E. Corette Plant. • Trucked 1,457 tons of SynCoal® to Colstrip Units 3 and 4. • Continued process testing to reduce spontaneous combustion tendency. • Converted to a single process train operation. • Identified process fines slurry capacity limitation. • Met with United States Bureau of Mines and DOE researchers about coal oxidation studies.
December 1992	<ul style="list-style-type: none"> • Trucked 317 tons of SynCoal® to Colstrip Units 3 and 4. • Continued process testing to reduce spontaneous combustion tendency. • Produced a passivated product with a two-week storage life. • Identified design problem with process gas ductwork expansion joints.

2.2 PROJECT PROGRESS SUMMARY

Original design and construction work is complete. All ACCP Demonstration Project equipment and systems are operational with the exception of the processed fines briquetter system. However, during the Fourth Quarter, the product's instability and limited plant reliability have restricted the facility's operating factor to about 27.2 percent and raw coal feed rate to less than 10 percent of nominal design capacity. To date, about 28,686 tons of raw coal have been fed to the process, producing about 14,000 tons of uncleaned and cleaned product. A little over 5,566 tons have been test shipped, showing that product dustiness is an issue that needs to be addressed.

Modifications and major maintenance work during the reporting period focused on:

- installing first-stage PRS screw conveyor;
- installing fan insulation;
- starting pump house installation for cold weather;
- installing a mass spectrometer for process gas analysis;
- installing an automatic knife and divert gates on the process surge bins;
- installing a larger cooling water line to the cooling tower for increased quench cooling capacity;
- installing an uninterruptible power supply (UPS);
- installing new Flights on C-15;
- installing liquid carbon dioxide storage and vaporization system for testing;
- upsizing cooler bed holes for increased cooling gas flow;
- replacing the main process heat exchanger expansion joint;
- upgrading fan shaft seal to limit oxygen infiltration into the process gas;
- fabricating test fixtures for barrel tests (silo simulation tests);
- replacing every bearing on the drying and cooling vibro-fluidized beds, due to a factory flaw;
- modifying the dust conveying and handling equipment; and
- modifying temporary slurry disposal system.

During the Third Quarter of 1992, modifications and major maintenance work involved:

- repairing second-stage vibratory fluid bed reactors;
- sealing the process gas heat exchanger;
- modifying the processed fines conveying equipment; and
- installing temporary slurry fines disposal system.

During Second Quarter of 1992, modifications and major maintenance work focused on:

- upgrading the process rotary air locks;
- rebuilding the dryer hood seals;
- improving the vibratory fluidized beds;
- modifying the processed fines conveying equipment;
- rewriting operator graphic interface programs;
- replacing and upgrading the explosion relief panels; and
- replacing prematurely worn drag conveyor flights.

During the First Quarter of 1992, modifications and major maintenance work focused on:

- rebuilding process gas fan foundation pedestals;
- rebuilding air compressor foundations;
- replacing rotor shafts on second-stage fans;
- removing and redesigning shaft seals on process gas fans;
- rewriting operator graphic interface programs; and
- replacing, redesigning, and upgrading the explosion relief panels.

The product produced to date has been exceptionally close to the design basis product from a chemical standpoint. The typical product analyses are shown in Table 2.2.

Table 2.2. ACCP Quarterly Analysis Summary

	TM	PA	PS	HHV	SO ₂
First Quarter Product					
None					
Second Quarter Product					
Average	3.47	9.14	0.53	11,615	0.91
Standard Deviation	0.77	0.99	0.08	144	0.16
Min.	2.28	8.34	0.45	11,240	0.78
Max.	4.93	12.81	0.87	11,857	1.55
Third Quarter Product					
Average	1.69	9.61	0.57	11,913	0.96
Standard Deviation	0.36	0.75	0.04	136	0.07
Min.	1.18	8.49	0.52	11,719	0.86
Max.	2.30	11.41	0.64	12,149	1.09
Fourth Quarter Product					
Average	2.07	9.51	0.53	11,907	0.88
Standard Deviation	0.35	0.38	0.05	74	0.09
Min.	1.17	8.30	0.44	11,676	0.74
Max.	3.26	10.17	0.67	12,116	1.13
TM - % Total Moisture PA - % Ash PS - % Sulfur HHV - Btu/lb. SO ₂ - lbs. of SO ₂ /MMBtu					

3.0 PROCESS DESCRIPTION

In general, the ACCP is a drying and conversion process that uses combustion products and superheated steam as fluidizing gas in vibrating fluidized beds. Two fluidized stages are used to heat and dry the coal, and one water spray stage followed by one fluidized stage is used to cool the coal. Other systems that service and assist the coal conversion system include:

- Coal Conversion;
- Coal Cleaning;
- Product Handling;
- Raw Coal Handling;
- Emission Control;
- Heat Plant;
- Heat Rejection; and
- Utility and Ancillary.

The central processes are depicted in Figure 3.1 on the proceeding page. The following discusses plant design aspects and expected results. Work to date has not verified these aspects or results.

Coal Conversion

Coal conversion is performed in two parallel processing trains. Each train consists of two, 5-feet-wide by 30-feet-long, vibratory fluidized bed dryer/reactors in series, followed by a water spray section, and a 5-feet-wide by 25-feet-long, vibratory cooler. Each processing train is fed 1,139 pounds per minute of 2-by-1/2 inch coal.

In the first-stage dryer/reactors, the coal is heated using recirculated combustion gases, removing primarily surface water from the coal. The coal exits the first-stage dryer/reactors at a temperature slightly above that required to evaporate water. After the coal exits the first-stage dryer/reactor, it is gravity fed to the second-stage dryer/reactors, which further heats the coal using a recirculating gas stream, removing water trapped in the pore structure of the coal and promoting decarboxylation. The water, which makes up the superheated steam used in the second stage, is actually produced from the coal itself. Particle shrinkage that occurs in the second stage liberates ash minerals and passes on a unique cleaning characteristic to the coal.

As the coal exits the second-stage dryer/reactors, it falls through vertical coolers where process water is sprayed onto the coal to reduce the temperature. The water vaporized during this operation is drawn back into the second-stage dryer/reactors. After water quenching, the coal enters the vibratory coolers where the coal is contacted by cool inert gas. The coal exits the vibratory cooler(s) at less than 150°F and enters the coal cleaning system. The gas that exits the vibratory coolers is cooled by water sprays in contact coolers prior to returning to the vibratory coolers.

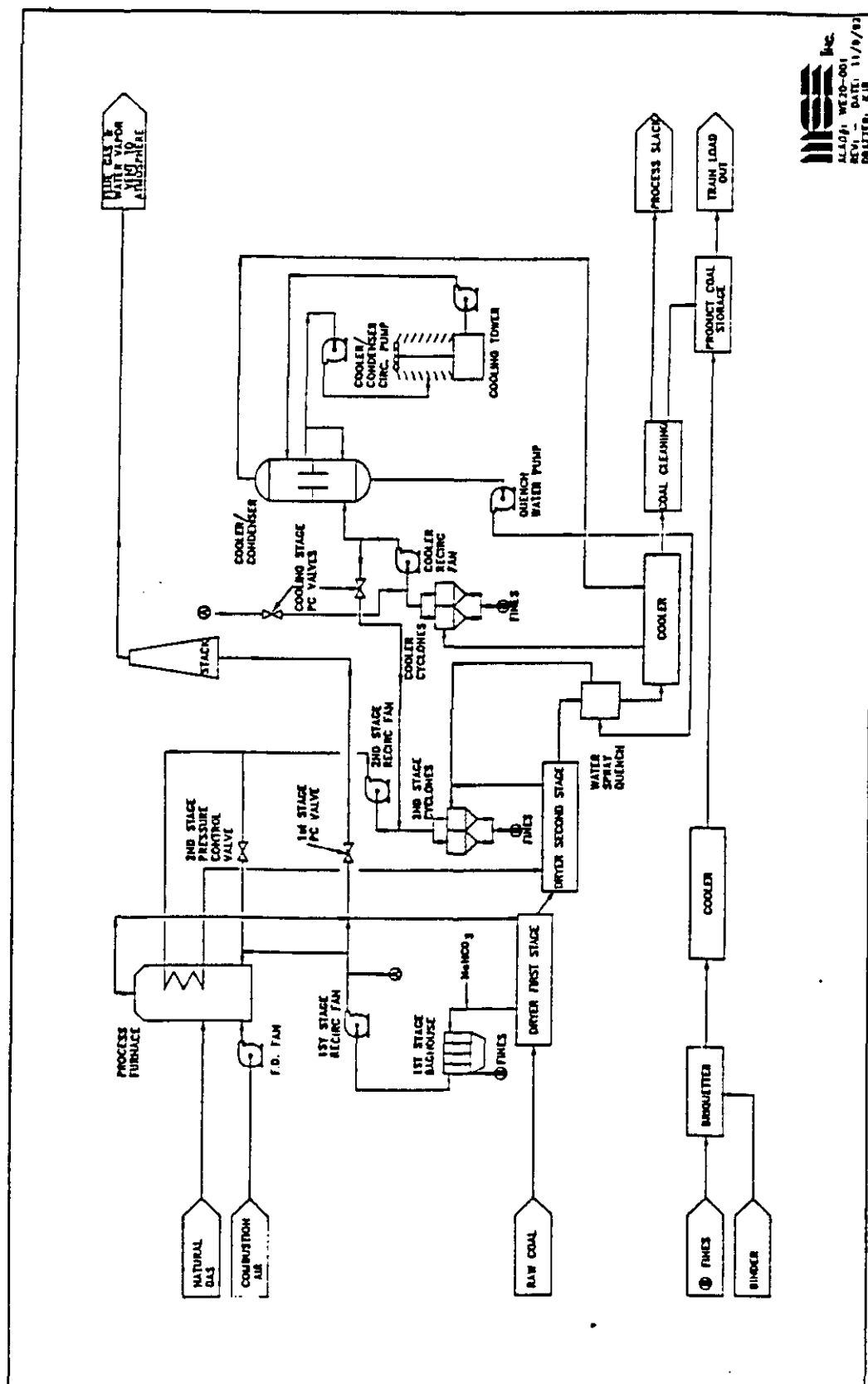


Figure 3.1 Central Processes

Three interrelated recirculating gas streams are used in the coal conversion system; one each for the dryer/reactors and one for the vibratory coolers.

Gases enter the process from either the natural gas-fired process furnace or the coal itself. Combustion gases from the furnace are used in the first-stage dryer/reactors after transferring some heat to the second-stage gas stream. The second-stage gas stream is composed mainly of superheated steam, which is heated by the furnace combustion gases in the heat exchanger. The cooler gas stream is made up of cooled furnace combustion gases that have been routed through the cooler loop.

A gas route is available from the cooler gas loop to the second-stage dryer/reactor loop. Gas may also enter the first-stage dryer/reactor loop from the second-stage loop (termed make-gas) without directly entering the first-stage dryer/reactor loop; rather, the make-gas is used as an additional fuel source in the process furnace. The final gas route is the exhaust stream from the first-stage loop to the atmosphere.

Gas exchange from one loop to another is governed by pressure control on each loop, and after startup, will be minimal from the first-stage loop to the cooler loop and from the cooler loop to the second-stage loop. Gas exchange from the second-stage loop to first-stage loop (through the process furnace) may be substantial since the water vapor and hydrocarbons driven from the coal in the second-stage dryer/reactors must leave the loop to maintain a steady state.

In each gas loop, particulate removal devices that remove dust from the gas streams protect the fans. The control emissions are upstream of the fans.

Coal Cleaning

The coal entering the cleaning system is screened into four size fractions: plus 1/2 inch, 1/2 by 1/4 inch, 1/4 inch by 6 mesh, and minus 6 mesh. These streams are fed in parallel to four, deep-bed stratifiers (stoners) where a rough specific gravity separation is made using fluidizing air and a vibratory conveying action. The light streams from the stoners are sent to the product conveyor; the heavy streams from all but the minus 6 mesh stream are sent to fluidized bed separators. The heavy fraction of the minus 6 mesh stream goes directly to the waste conveyor. The fluidized bed separators, again using air and vibration to effect a gravity separation, each split the coal into light and heavy fractions. The light stream is considered product; the heavy or waste stream is sent to a 300-ton, storage bin to await transport to an off-site user or alternately back to a mined out pit disposal site. The dried, cooled, and cleaned product from coal cleaning enters the product handling system.

Product Handling

Product handling consists of the equipment necessary to convey the clean product coal into two, 6,000-ton, concrete silos and to allow train loading with the existing loadout system.

Raw Coal Handling

Raw coal from the existing stockpile is screened to provide 2-by-1/2 inch feed for the ACCP process. Coal rejected by the screening operation is conveyed back to the active stockpile. Properly sized coal is conveyed to a 1,000-ton, raw coal, storage bin which feeds the process facility.

Emission Control

Sulfur dioxide emission control philosophy is based on injecting dry sorbents into the ductwork to minimize the release of sulfur dioxide to the atmosphere. Sorbents, such as trona or sodium bicarbonate, are injected into the first-stage dryer gas stream as it leaves the first-stage dryers to maximize the potential for sulfur dioxide removal while minimizing reagent usage. The sorbents, having reacted with sulfur dioxide, are removed from the gas streams in the particulate removal systems. A 60-percent reduction in sulfur dioxide emissions should be realized.

The coal cleaning area fugitive dust is controlled by placing hoods over the sources of fugitive dust conveying the dust laden air to fabric filter(s). The bag filters can remove 99.99 percent of the coal dust from the air before discharge. All coal fines will report to a briquetter and ultimately the product stream.

Heat Plant

The heat required to process the coal is provided by a natural gas-fired process furnace, which uses process make-gas from coal conversion as fuel. This system is sized to provide a heat release rate of 74 MM Btu/hr. Process gas enters the furnace and is heated by radiation and convection from the burning fuel.

Heat Rejection

Most heat rejection from the ACCP is accomplished by releasing water and flue gas into the atmosphere through an exhaust stack. The stack design allows for vapor release at an elevation great enough that, when coupled with the vertical velocity resulting from a forced draft fan, dissipation of the gases will be maximized. Heat removed from the coal in the coolers is rejected using an atmospheric-induced, draft cooling tower.

Utility and Ancillary Systems

The coal fines that are collected in the conversion, cleaning, and material handling systems are gathered and conveyed to a surge bin. The coal fines are then agglomerated and returned to the product stream.

Inert gas is provided by cooling and drying combustion flue gases. This gas, primarily nitrogen and carbon dioxide, is used principally for baghouse pulse and for make-gas in the cooler loop.

The common facilities for the ACCP include a plant and instrument air system, a fire protection system, and a fuel gas distribution system.

The power distribution system includes a 15 kV service; a 15 kV/5 kV transformer; a 5 kV motor control center; two, 5 kV/480 V transformers; a 480 V load distribution center; and a 480 V motor control center.

The process is fully automated, including dual control stations, dual programmable logic controllers, and distributed plant control and data acquisition hardware.

3.1 ORIGINAL EQUIPMENT

The originally designed and installed major equipment for the ACCP Demonstration Facility is shown in Table 3.1.

Table 3.1. Advanced Coal Conversion Process Major Plant Equipment

System Description	Equipment Vendor	Type
Coal Dryers/Coolers	Carrier Vibrating Equipment, Inc.	PE
Belt Conveyors	Willis & Paul Group	MH
Bucket Elevators	FMC Corporation	MH
Coal Cleaning Equipment	Triple S Dynamics, Inc.	CC
Coal Screens	Hewitt Robbins Corporation	MH
Loading Spouts	Midwest International	MH
Dust Agglomerator	Royal Oak Enterprises, Inc.	DH
Silo Mass Flow Gates	SEI Engineers, Inc.	MH
Vibrating Bin Dischargers	Carman Industries, Inc.	MH
Vibrating Feeder	Kinergy Corporation	MH
Drag Conveyor	Dynamet	DH
Process Gas Heater	G.C. Broach Company	PE
Direct Contact Cooler	CMI-Schneible Company	PE
Particulate Removal System	Air-Cure Howden	EC
Dust Collectors	Air Cure Environmental, Inc.	EC
Air Compressors/Dryers	Colorado Compressor, Inc.	CF
Diesel Fire Pumps	Peerless Pump Company	CF
Forced Draft Fans	Buffalo Forge Company	PE
Pumps	Dresser Pump Division Dresser Industries, Inc.	PE
Electrical Equipment-4160	Toshiba/Houston International Corporation	CF
Electrical Equipment-LDC	Powell Electric Manufacturing Company	CF
Electrical Equipment-480v MCC	Siemens Energy & Automation, Inc.	CF
Main Transformer	ABB Power T&D Company	CF
Control Panels	Utility Control & Equipment Corporation	CF
Control Valves	Applied Control Equipment	CF
Plant Control System	General Electric Supply Company	CF
Cooling Tower	The Marley Cooling Tower Company	PE
Dampers	Effox, Inc.	PE
Dry Sorbent Injec. System	Natech Resources, Inc.	EC
Expansion Joints	Flexonics, Inc.	PE
MH - Materials Handling PE - Process Equipment EC - Emissions Control CF - Common Facilities CC - Coal Cleaning • DH - Dust Handling		

3.2 MODIFIED OR REPLACED EQUIPMENT

Facility modifications and maintenance work to date have been dedicated to obtaining an operational facility.

The modifications to the original system performed for the year to date (with modifications during this reporting period shown in bold print) involved:

Fourth Quarter 1992:

Instrumentation:

- installing a mass spectrometer for process gas analysis;

General:

- starting pump house installation for cold weather,
- installing an automatic knife and divert gates on the process surge bins, and
- installing liquid carbon dioxide storage and vaporization system for testing;

Cooling Tower:

- installing a larger cooling water line to the cooling tower for increased quench cooling capacity;

Electrical Equipment:

- installing an uninterruptible power supply (UPS);

Process Gas Heater:

- replacing the main process heat exchanger expansion joint;

Forced Draft Fans:

- upgrading fan shaft seal to limit oxygen infiltration into the process gas, and
- installing fan insulation;

Dryers/Coolers:

- replacing every bearing on the drying and cooling vibro-fluidized beds, due to a factory flaw, and
- upsizing cooler bed holes for increased cooling gas flow; and

Draw Conveyors/Screw Conveyors:

- installing new Flights on C-15,
- modifying the dust conveying and handling equipment,
- modifying temporary slurry disposal system, and
- installing first stage PRS screw conveyor.

Third Quarter 1992:**Coal Dryers/Coolers:**

- repairing second-stage vibratory fluid bed reactors;

Process Gas Heater:

- sealing the process gas heat exchanger; and

Drag Conveyors:

- modifying the processed fines conveying equipment, and
- installing temporary slurry fines disposal system.

Second Quarter 1992:**Coal Dryers/Coolers:**

- upgrading process rotary air locks - increased from 2 to 5 hp and adding reversing starters,
- rebuilding dryer hood seals - fixed seal design problems and seal leaking joints, and
- improving the vibratory fluidized beds - eliminate process gas bypass/welding out seams, etc.;

Drag Conveyor:

- modifying processed fines conveying equipment to reduce required throughput on drag conveyors by adding a first stage screw conveyor and straightening and shortening tubular drag conveyors;

Plant Control System:

- continued rewriting operator graphic interface programs; and

General:

- replacing and upgrading explosion relief panels - went through design/trials.

First Quarter 1992:**Air Compressors/Dryers:**

- rebuilding air compressor foundations;

Forced Draft Fans:

- rebuilding foundation pedestals for process gas fans,
- replacing rotor shafts on second-stage fans, and
- removing and redesigning shaft seals on process gas fans.

Table 3.2 shows the equipment that has either been modified or replaced. If replacement was required, the new equipment is listed.

Figure 3.2 shows the modified Process Flow Diagram, including the temporary slurry disposal to the slurry pit.

Table 3.2. Advanced Coal Conversion Process Modified Major Plant Equipment

System Description	Equipment Vendor	Type	Modified No/Yes	Replaced With
Coal Dryers/Coolers	Carrier Vibrating Equipment, Inc.	PE	/✓	
Belt Conveyors	Willis & Paul Group	MH	/	
Bucket Elevators	FMC Corporation	MH	/	
Coal Cleaning Equipment	Triple S Dynamics, Inc.	CC	/	
Coal Screens	Hewitt Robbins Corporation	MH	/	
Loading Spouts	Midwest International	MH	/	
Dust Agglomerator	Royal Oak Enterprises, Inc.	DH	/	
Silo Mass Flow Gates	SEI Engineers, Inc.	MH	/	
Vibrating Bin Dischargers	Carman Industries, Inc.	MH	/	
Vibrating Feeder	Kinergy Corporation	MH	/	
Drag Conveyor	Dynamet	DH	/✓	
Screw Conveyor	Farm Aid Equipment Company	MH	Added	
Process Gas Heater	G.C. Broach Company	PE	/✓	
Direct Contact Cooler	CMI-Schneible Company	PE	/✓	
Particulate Removal System	Air-Cure Howden	EC	/	
Dust Collectors	Air Cure Environmental	EC	/	
Air Compressors/Dryers	Colorado Compressor, Inc.	CF	/✓	
Diesel Fire Pumps	Peerless Pump Company	CF	/	
Forced Draft Fans	Buffalo Forge Company	PE	/✓	
Pumps	Dresser Pump Division Dresser Industries, Inc.	PE	/	
Electrical Equipment-4160	Toshiba/Houston International Corp.	CF	/	
Electrical Equipment-LDC	Powell Electric Manufacturing Corp.	CF	/	
Electrical Equipment-480v MCC	Siemens Energy & Automation, Inc.	CF	/✓	
Main Transformer	ABB Power T&D Company	CF	/	
Control Panels	Utility Control & Equipment Corp.	CF	/	
Control Valves	Applied Control Equipment	CF	/	
Plant Control System	General Electric Supply Company	CF	/✓	
Cooling Tower	The Marley Cooling Tower Company	PE	/✓	
Dampers	Effox, Inc.	PE	/	
Dry Sorbent Injec. System	Natech Resources, Inc.	EC	/	
Expansion Joints	Flexonics, Inc.	PE	/✓	
MH - Materials Handling PE - Process Equipment EC - Emissions Control CF - Common Facilities CC - Coal Cleaning DH - Dust Handling				

Process Flow Diagram

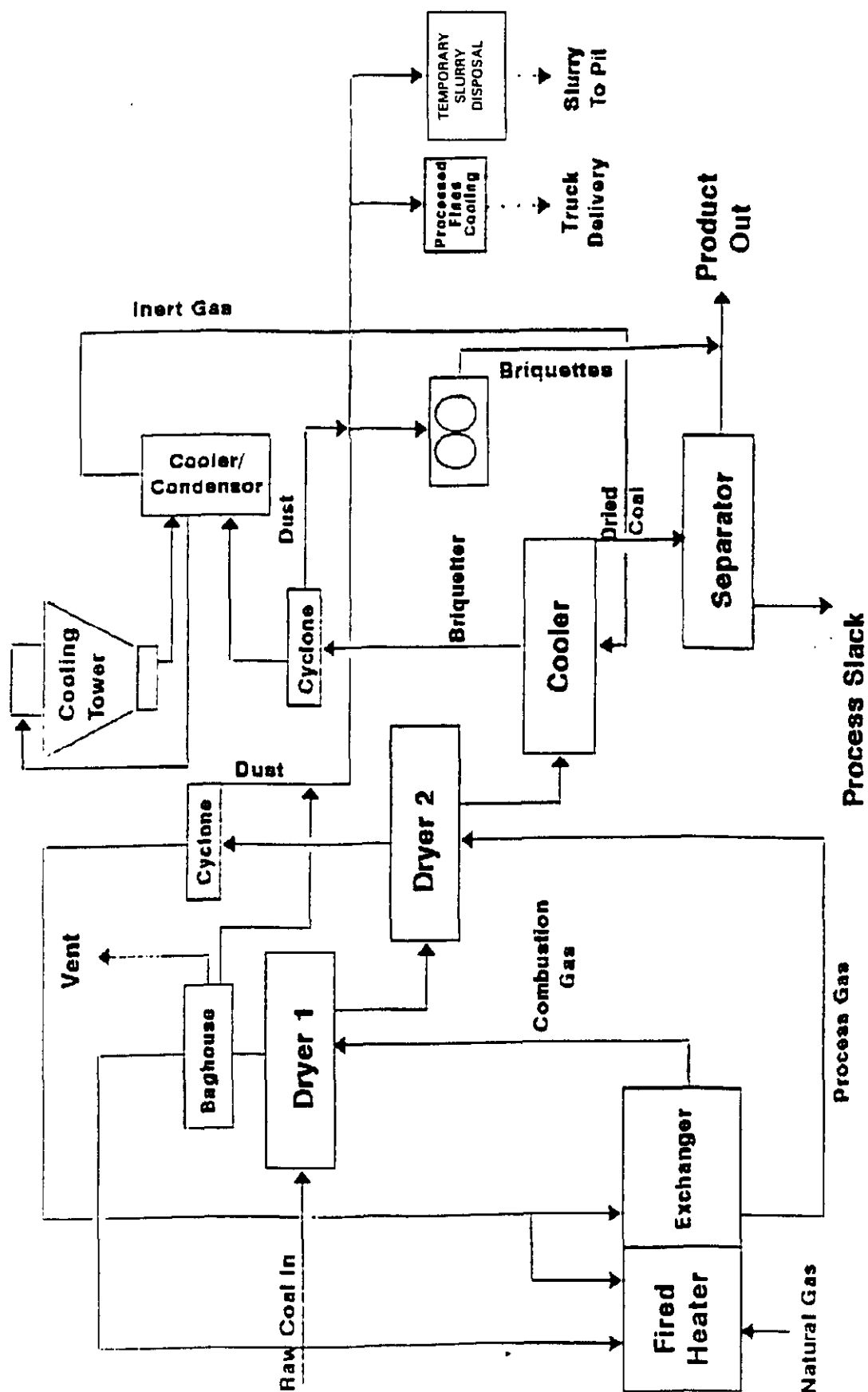


Figure 3.2 Modified Process Flow Diagram

Flowdgm

4.0 TECHNICAL PROGRESS

4.1 FACILITY OPERATIONS/PLANT PRODUCTION

Table 4.1 summarizes the ACCP Demonstration Facility's operations and plant production levels that have been achieved through the reporting period and the facility's lifetime to date. Table 4.2 lists the ACCP Demonstration Facility's monthly shipments of the SynCoal® product.

The difference between the feed coal and the amount of clean coal produced is due to water loss; samples removed for analysis; and process fines, which are captured in the particulate removal system and cleaning system dust collector and returned to the mine for disposal. Very little dust is actually lost to the atmosphere.

Approximately 1,300 tons of product coal were shipped to MPC's Corette Power Plant in Billings, Montana, and approximately 2,000 tons of product coal were shipped to MPC's Colstrip Project, Units 3 and 4 during the Fourth Quarter of 1992.

4.2 FACILITY TESTING

Facility modifications and maintenance to date have been dedicated to obtaining a more reliable facility, therefore, focusing on modifying the fines conveying equipment, process surge bins, slurry disposal process, duct expansion joints, fan bearings, first stage screw conveyor, and fan insulation installation; increasing cooling tower capacity; and installing liquid CO₂ storage and vaporization system.

Testing during October included testing at the pilot plant in Butte, Montana. The pilot tests were run to determine the effects of high dryer outlet temperatures and higher cooling gas carbon dioxide concentrations on product quality. Barrel tests were also performed on pilot plant product to make an accurate determination of make gas.

Testing during the remainder of the Fourth Quarter mainly involved passivation testing to inhibit the spontaneous combustion tendency of the product. Test results have shown some success with some passivated product having a storage life of two (2) weeks.

Facility testing to date has focused on understanding and controlling product stability. Six tests have been performed at the facility during the reporting period, and one, pilot-plant test was performed in Butte. These tests are summarized in Tables 4.3 and 4.4, respectively.

Table 4.1. ACCP Demonstration Project Monthly Operating Statistics

Month	Operating Hours	Operating Factor	Non-Scheduled Hours	Schedule Factor	Scheduled Operating Factor	Feed Tons	Ave. Feedrate	Feed Capacity Factor	Total Shipments	Ending Silo Inventory	Comments
Mar. '92	33	4.4%	0	100.0%	4.4%	700	21.21	1.9%	181	0	Est Feed Tons/Hours
Apr. '92	47	6.5%	288	60.0%	10.9%	411	8.74	1.1%	212	0	Est Feed Tons/Hours
May '92	89	12.0%	366	50.8%	23.5%	2,757	30.98	7.4%	0	0	Silo Heating Problem Encountered
Jun. '92	95	13.2%	225	68.8%	19.2%	2,496	26.27	6.7%	214	0	Dedication 6/25, Corette shipment 6/17
2nd Quarter 1992 Summary	231	10.6%	879	59.8%	17.7%	5,664	24.52	5.0%	426	0	
July '92	53	7.1%	624	16.1%	44.2%	1,436	27.09	3.8%	0	0	Start Formal Process Testing
Aug. '92	124	16.7%	432	41.9%	39.7%	1,860	15.00	5.0%	61	0	Operator Training/Production Runs
Sept. '92	315	43.8%	252	65.0%	67.3%	8,725	27.70	23.3%	1,672	0	Corette Truck Shipments
3rd Quarter 1992 Summary	492	22.3%	1,308	40.8%	54.7%	12,021	24.43	10.7%	1,733	0	
Oct. '92	97	13.0%	480	35.5%	36.7%	2,292	23.63	6.1%	523	0	Winterization Outage
Nov. '92	420	58.3%	139	80.7%	72.3%	6,946	16.54	18.5%	2,386	0	Dust Conveying Problems/Slurry Freezing
Dec. '92	84	11.3%	332	55.4%	20.4%	1,063	12.65	2.8%	317	0	Expansion Joint Failure/Major Outage
4th Quarter 1992 Summary	601	27.2%	951	56.9%	47.8%	10,301	17.14	9.2%	3,226	0	
Totals	1,357	18.5%	3,138	57.3%	32.3%	28,686	21.14		5,566	0	

Table 4.2. ACCP Demonstration Project Monthly Shipments

Month	Total Shipments	Shipments by Customer (tons)		
		MPC Corette	Units 3 & 4	CELP Montana 1
Mar. '92	by truck	0	0	181
Apr. '92	by truck	0	0	212
May '92	0	0	0	0
Jun. '92	2.5 cars	214	0	0
2nd Quarter 1992 Summary		214	0	212
July '92	0	0	0	0
Aug. '92	by truck	0	61	0
Sept. '92	by rail	1,672	0	0
3rd Quarter 1992 Summary		1,672	61	0
Oct. '92	by truck	329	194	0
Nov. '92	by truck	929	1,457	0
Dec. '92	by truck	0	317	0
4th Quarter 1992 Summary		1,258	1,968	0
Totals		3,144	2,029	393

Table 4.3. ACCP Demonstration Plant Testing Summary

Test Number	Test Description	Test Dates
9206-B	Determined particle degradation and dryer residence times under cold flow conditions.	10/26/92 - 10/27/92
9208	Explored various spontaneous heating mitigation treatments.	10/29/92 - 11/5/92
9209	Determined the drag conveyors and slurry system for dust handling are undersized.	11/10/92 - 11/19/92
9210	Determined the effects of purging the storage bin with CO ₂ before dumping the coal for enhanced product stability.	12/19/92 - 12/27/92
9210-B	Determined processed coal passivated with CO ₂ lasts three times longer than untreated product.	12/10/92
9216	Explored blend testing to isolate the spontaneous heating variables using 55-gallon barrels.	11/17/92 - 11/20/92

As part of the initial production period, baseline testing of the process is being performed. Compliance monitoring of the particulate removal systems still remains to be completed.

Table 4.4. ACCP Pilot Plant Testing Summary

Test Number	Test Description	Test Dates
P92C	Determined the effects of high dryer outlet temperatures and higher cooling gas carbon dioxide concentrations on product quality.	10/15/92 - 10/25/92

4.3 PRODUCT TESTING

The product produced to date has been exceptionally close to the design basis product from a chemical standpoint but has not been acceptable from a physical standpoint due to instability (spontaneous heating) and dustiness. The coal appears to continue to heat after processing. Work with the United States Bureau of Mines, DOE, and independent consultants has led to the conclusion that product stability will be obtained by focusing on one or more of the following variables:

- product rehydration (amount and time);
- product oxidation (quantity and time);
- product cooling (amount and time); and
- product pacification.

Product analyses during the reporting period are shown in Table 4.5.

Table 4.5. ACCP Quality Analyses for 1992 Annual Report

		RAW COAL									
SECOND QUARTER, 1992	SAMPID	SAMPDATE	TONNAGE	TM	PA	PS	HHV	SO ₂	COMM		
RAW COAL	786	05/28/92	1	24.08	9.53	1.11	8.861	2.51	C-1.05, 07.20, Topsize = +1.25"		
	808	05/30/92	1	24.17	7.57	0.83	9.028	1.40	W-78 RAW, 05.30, Topsize = +3/4"		
	891	06/11/92	1	23.23	7.29	0.48	8.978	1.02	C-1.05 07.55, Topsize = +1 1/2 in.		
	858	06/11/92	1	23.30	7.87	0.75	8.138	1.84	C-1.5, 05.30/06.30, TOPSIZE = +1.50 in.		
	890	06/11/92	1	21.88	8.95	0.88	8.867	1.47	C-1.05 22.55, Topsize = +1 1/2 in.		
	873	06/12/92	1	22.87	8.98	0.88	9.044	1.80	C-1.05 composite, Topsize = 1.5 in.		
	916	06/16/92	1	23.53	8.13	0.75	8.974	1.87	C-1.05, Topsize = +1 1/2 in.		
	908	06/16/92	1	23.55	8.65	0.65	8.853	1.45	C-1.05, 02.15, Topsize = +1 1/2 in.		
	838	06/21/92	1	23.43	8.20	0.88	9.074	1.80	C-S RAW, 11.30.		
	AVERAGE			23.34	8.57	0.75	8.904	1.68			
STANDARD DEVIATION				0.85	0.85	0.17	75	0.38			
MIN				21.88	7.29	0.48	8.861	1.02			
MAX				24.17	8.95	1.11	8.138	2.51			

LEGEND	
TM	% Total Moisture
PA	% Ash
PS	% Sulfur
HHV	Btu/lb.
SO ₂	lbs. of SO ₂ /MMBtu
COMM	Comments

Table 4.5. ACCP Quality Analyses for 1992 Annual Report (cont'd.)

SECOND QUARTER, 1992	PRODUCT	SAMPID	SAMPDATE	TONNAGE	TM	PA	PS	HHV	SO2	COMM
		795	05/28/92	1	4.47	9.00	0.52	11,552	0.90	C-9, 11, 18, 20, Topsize = 3/8"
		787	05/28/92	1	3.22	8.90	0.50	11,728	0.85	C-8, 07, 00, Topsize = 1 No. 4 No air dry Reported value
		786	05/28/92	1	4.78	9.37	0.49	11,387	0.88	C-11, 02, 00, TOPSIZE = 1/4"
		787	05/28/92	1	3.14	9.22	0.48	11,695	0.82	C-8, 07, 00, Air dried. This value not reported
		783	05/28/92	1	3.32	8.34	0.54	11,748	0.92	C-8, 08, 02, 30, Topsize = 1/4"
		797	05/29/92	1	4.83	9.21	0.53	11,455	0.93	C-8, 08, 05, 20, Topsize = 1/2"
		807	05/30/92	1	3.62	8.77	0.54	11,589	0.93	C-8, 08, 01, 30, Topsize = 1/4"
		805	05/30/92	1	3.49	8.88	0.53	11,674	0.91	C-8, 08, 05, 30, Topsize = 3/8"
		85	06/11/92	1	2.82	8.63	0.48	11,823	0.81	C-9, 8, 11, 00, Topsize = 3/8 in
		890	06/11/92	1	3.92	8.45	0.45	11,575	0.78	C-8, 08
		886	06/11/92	1	2.69	8.68	0.51	11,662	0.87	C-8, 08, 23, 10
		859	06/11/92	1	3.33	8.58	0.47	11,888	0.80	11,00, 60 MESH REPEATER
		895	08/11/92	1	3.73	8.94	0.51	11,512	0.89	60 MESH REPEATER
		895	08/11/92	1	2.59	8.82	0.53	11,683	0.91	C-8, 08, 08, 30
		874	08/12/92	1	3.69	8.75	0.51	11,806	0.86	C-8, 08 composite, Topsize = 3/8 in.
		907	09/18/92	1	2.98	10.25	0.52	11,850	0.89	C-08, 02, 45, Topsize = 3/8 in
		912	09/18/92	1	4.60	8.40	0.51	11,558	0.88	C-9, 08, 10, 15, Topsize = 1/4 in
		936	09/21/92	1	2.54	8.52	0.51	11,857	0.88	C-8 Prod 11,30
		938	09/21/92	1	2.28	12.81	0.87	11,240	1.55	T85 loadout, 20,00
		AVERAGE			3.47	9.14	0.53	11,615	0.91	
		STANDARD DEVIATION			0.77	0.98	0.08	143	0.18	
		MIN			2.28	8.34	0.45	11,240	0.79	
		MAX			4.93	12.81	0.87	11,657	1.55	
		1228	09/03/92	1	1.68	8.82	0.60	11,828	1.01	C-13, 13, 00, TRUCK TO CORRIE
		1259	09/06/92	1	2.30	9.40	0.84	11,728	1.08	C-13, 500°F, 1000
		1281	09/08/92	1	1.60	8.80	0.50	11,088	0.93	C-13, 700°F, 11,30
		1260	09/08/92	1	2.14	8.28	0.63	11,788	1.07	C-13, 800°F, 02,00
			09/14/92		1.38	11.41	0.60	11,719	1.02	
			09/16/92		1.77	9.78	0.57	11,848	0.98	
			09/17/92		2.22	8.49	0.52	11,805	0.87	
			09/23/92		1.27	9.41	0.57	11,803	0.95	
			09/25/92		1.85	8.42	0.57	11,896	0.98	
		1385	09/28/92	1	1.18	10.14	0.55	12,149	0.81	C-8, 20, 10
		1383	09/29/92	1	1.42	10.33	0.52	12,090	0.88	C-8, 18, 10
			09/30/92		1.41	8.84	0.53	12,037	0.88	
		AVERAGE			1.69	9.61	0.57	11,913	0.88	
		STANDARD DEVIATION			0.38	0.75	0.04	138	0.07	
		MIN			1.18	8.49	0.52	11,718	0.88	
		MAX			2.30	11.41	0.84	12,149	1.09	
		1387	10/01/92	1	1.17	9.52	0.53	12,118	0.87	C-8, 08, 40
			10/01/92		1.37	9.68	0.58	11,982	0.93	
		1538	10/31/92	1	2.20	9.54	0.49	11,883	0.83	Small sample - No reference kept
			10/31/92		1.82	9.45	0.48	11,878	0.77	
		1538	11/01/92	1	2.42	8.95	0.47	11,845	0.79	
			11/01/92		2.07	9.20	0.44	11,850	0.74	
			11/05/92		1.82	9.45	0.46	11,878	0.77	
		1593	11/08/92	1	2.50	8.01	0.52	11,888	0.87	
			11/08/92		2.07	8.20	0.44	11,950	0.74	
			11/08/92		1.87	9.07	0.48	11,881	0.80	
			11/08/92		2.29	8.89	0.48	11,821	0.91	
		1594	11/10/92	1	2.13	9.11	0.52	11,858	0.87	
			11/10/92		1.93	8.11	0.50	11,971	0.84	

Table 4.5. ACCP Quality Analyses for 1992 Annual Report (cont'd.)

1602	11/11/92	1	2.10	9.06	0.48	11,926	0.80
	11/11/92		1.87	9.07	0.48	11,961	0.80
1633	11/13/92		2.29	8.89	0.48	11,921	0.81
	11/17/92	1	2.10	8.80	0.48	11,988	0.82
	11/17/92		1.88	8.87	0.47	12,026	0.78
1644	11/18/92	1	2.23	9.87	0.48	11,872	0.81
	11/18/92		1.88	9.81	0.49	11,910	0.82
1663	11/19/92	1	3.28	10.07	0.51	11,878	0.87
	11/19/92		2.95	10.04	0.51	11,704	0.87
1688	11/24/92	1	1.70	9.76	0.58	11,838	0.87
	11/24/92		2.18	9.88	0.59	11,830	1.00
1688	11/24/92	1	1.68	8.77	0.58	11,939	0.84
	11/24/92		1.68	8.89	0.54	11,878	0.81
1690	11/25/92	1	1.48	9.78	0.55	11,963	0.82
	11/25/92		2.05	8.71	0.58	11,955	0.84
1694	11/26/92	1	2.01	9.81	0.55	11,838	0.93
	11/26/92		2.10	9.86	0.53	11,867	0.89
1692	11/27/92	1	1.85	8.81	0.51	11,870	0.88
	11/27/92		2.37	9.82	0.52	11,849	0.88
1693	11/28/92	1	2.30	9.77	0.52	11,836	0.88
	11/28/92		2.15	10.17	0.67	11,830	1.13
1697	11/29/92	1	1.97	10.12	0.82	11,889	1.04
	11/29/92		2.58	8.83	0.82	11,814	1.05
1712	11/30/92	1	2.30	10.03	0.60	11,842	1.01
	11/30/92		1.88	9.58	0.52	11,843	0.87
1733	12/09/92	1	1.73	9.53	0.52	11,950	0.87
	12/09/92		2.14	9.47	0.59	11,915	0.89
1736	12/10/92	1	2.23	9.22	0.53	11,900	0.89
	12/10/92		2.01	8.25	0.53	11,968	0.89
1737	12/10/92	1	1.83	8.32	0.49	11,988	0.82
	12/10/92		1.80	8.63	0.58	11,932	0.97
1744	12/11/92	1	2.23	8.45	0.57	11,939	0.95
	12/11/92		1.89	9.45	0.57	11,934	0.96
			2.07	9.51	0.53	11,907	0.88
AVERAGE			0.35	0.38	0.05	74	0.09
STANDARD DEVIATION			1.17	8.80	0.44	11,878	0.74
MIN			3.28	10.17	0.67	12,116	1.13
MAX							

Table 4.5. ACCP Quality Analyses for 1992 Annual Report (cont'd.)

DUST									
SAMPLED	SAMPLE DATE	TONNAGE	TM	PA	PS	HHW	SO2	COMM	
FIRST QUARTER, 1992									
508	03/26/92	1	0.82	8.84	0.64	12.035	1.06	PRS DUST, 1200. Topsize = No. 8	
507	03/28/92	1	2.12	8.55	0.65	11.768	1.10	Dust 05:30. Topsize = No. 18	
AVERAGE			1.47	8.25	0.65	11.901	1.08		
STANDARD DEVIATION			0.65	0.31	0.01	1.35	0.02		
MIN			0.82	8.84	0.64	11.768	1.06		
MAX			2.12	8.55	0.65	12.035	1.10		
SECOND QUARTER, 1992									
581	04/10/92	1	2.00	10.13	1.08	11.653	1.85	PRS DUST, 08:00. TOP SIZE = NO. 8	
592	04/12/92	1	0.72	10.10	0.98	11.842	1.86	4:00 AM. PRS DUST. TOPSIZE = No. 8	
593	04/12/92	1	0.70	10.04	1.02	11.840	1.72	8:00 AM. PRS DUST. TOPSIZE = No. 8	
808	05/30/92	1	3.28	8.83	0.90	11.498	1.57	T-87, 05:30. Topsize = + No. 20	
883	06/11/92	1	2.73	8.88	1.00	11.584	1.73	T-87 DUST. TOPSIZE = No. 18	
884	06/11/92	1	3.15	8.80	1.03	11.382	1.81	T-87 23:30. Topsize = + No. 20	
893	06/11/92	1	3.81	10.88	1.35	11.122	2.43	T-87. Topsize = No. 20	
887	06/11/92	1	2.80	8.81	0.83	11.668	1.42	T-87 DUST 13:00. Topsize = + No. 20	
881	06/11/92	1	4.19	8.82	0.65	11.458	1.13	Baghouse dust. 07:00. TOPSIZE = NO. 30	
885	06/11/92	1	4.83	7.81	0.57	11.348	1.00	AUGER 1ST. STAGE 14:00. Topsize = + No. 20	
881	06/12/92	1	4.42	8.41	0.73	11.282	1.30	1ST STAGE PRS 23:15. Topsize = NO. 30	
898	06/12/92	1	3.42	8.20	0.80	11.420	1.58	T-87 DUST COMPOSITE. Topsize = + No. 20	
878	06/12/92	1	4.88	8.83	0.88	11.289	1.17	1st stage baghouse dust composite. Topsize = No. 30	
913	06/18/92	1	2.74	8.38	0.80	11.482	1.05	1ST STAGE DUST, 10:30. Topsize = No. 30	
910	06/18/92	1	2.40	10.38	0.88	11.369	1.21	Topsite = No. 30. 1st stage dust, 03:00	
905	06/18/92	1	2.15	8.82	0.81	11.666	1.58	T87, 02:45. Topsize = + No. 20	
914	06/18/92	1	2.83	8.30	0.67	11.757	1.14	T87, 11:00. Topsize = + No. 20	
937	06/21/92	1	2.88	8.38	0.84	11.859	1.10	Auger Dust, 11:30	
AVERAGE			2.89	8.41	0.85	11.515	1.47		
STANDARD DEVIATION			1.18	0.82	0.20	2.00	0.36		
MIN			0.70	7.81	0.57	11.122	1.00		
MAX			4.88	10.88	1.35	11.842	2.43		
THIRD QUARTER, 1992									
1443	08/25/92	1	0.00	0.00	0.00	0	0.00	FIRST STAGE DUCT PARTICULATE. SENT TO CTE 10/14/92	
1442	08/25/92	1	0.00	0.00	0.00	0	0.00	SECOND STAGE DUCT PARTICULATE. SENT TO CTE 10/14/92	
1441	08/25/92	1	0.00	0.00	0.00	0	0.00	COOLER DUCT PARTICULATE. SENT TO CTE 10/14/92	
AVERAGE			0.00	0.00	0.00	0	0.00		
STANDARD DEVIATION			0.00	0.00	0.00	0	0.00		
MIN			0.00	0.00	0.00	0	0.00		
MAX			0.00	0.00	0.00	0	0.00		
FOURTH QUARTER, 1992									
1843	11/18/92	1	2.23	11.52	0.88	11.683	1.88		
1842	11/18/92	1	1.48	12.00	1.06	11.794	1.80		
AVERAGE			1.86	11.78	1.02	11.728	1.74		
STANDARD DEVIATION			0.38	0.24	0.04	65	0.08		
MIN			1.48	11.52	0.88	11.683	1.88		
MAX			2.23	12.00	1.06	11.794	1.80		

Table 4.5. ACCP Quality Analyses for 1992 Annual Report (cont'd.)

WASTE COAL										
SAMPID	SAMPDATE	TONNAGE	TM	PA	PS	HHV	SO2	COMM		
SECOND QUARTER, 1992										
798	05/29/92	1	3.46	34.31	4.74	6.138	11.65	C-8-09, 07:17, Topsize = +3/4"		
808	06/11/92	1	3.83	28.07	4.28	9.009	9.50	80 mesh repealer.		
862	08/11/92	1	2.48	25.15	2.78	9.583	5.82	C-8-09, 11:00, Topsize = +1.50 in.		
894	08/11/92	1	2.48	27.34	3.37	8.117	7.39	C-8-09 09:00, Topsize = 3/4 in.		
886	08/11/92	1	3.50	28.83	3.88	9.189	8.44	C-8-09 23:00, Topsize = +3/4 in.		
882	08/11/92	1	2.48	32.74	3.78	8.284	8.15	C-8-09 13:15, Topsize = 1 in.		
875	08/12/92	1	2.80	28.74	3.27	9.009	7.28	C-08-9 COMPOSITE, Topsize = +3/4 in.		
915	08/18/92	1	3.32	28.88	2.88	9.028	8.34	C-8-09, 10:42, Topsize = 1 1/4 in.		
941	08/21/92	1	2.70	21.89	3.38	10.070	8.71	C-8 WASTE, 11:30		
AVERAGE			3.00	28.21	3.58	8.048	8.03			
STANDARD DEVIATION			0.50	3.50	0.60	559	1.74			
MIN			2.48	21.88	2.78	8.139	5.82			
MAX			3.83	34.31	4.74	10.070	11.85			
FOURTH QUARTER, 1992										
1440	08/20/92	1	0.54	58.48	32.90	3.473	189.49			
1592	11/09/92	1	2.01	23.73	3.70	10.010	7.39			
1592	11/09/92	1	2.33	23.28	3.70	9.922	7.48	80 mesh repealer.		
AVERAGE			1.63	35.48	13.43	7.801	88.11			
STANDARD DEVIATION			0.78	18.98	13.77	3.081	85.83			
MIN			0.54	23.28	3.70	3.473	7.39			
MAX			2.33	58.48	32.80	10.010	189.49			

5.0 PROBLEM AREAS AND LESSONS LEARNED

Three major problem areas that are being addressed concurrently include:

Facility Reliability

Process gas leaks have proven to limit the facility's availability. The second-stage drying gas loop has been the most difficult to seal. Problems in containing the superheated gases in the second stage have been exacerbated in two cases where seal compression force was limited. The explosion relief panels were sealed using preload force from the same break-way clips that supply the predictable explosion relief pressure. The second location with limited seal force is the second-stage dryer hoods. The original hood design was inadequate to contain any significant positive pressure. Both areas are still causing periodic problems, but a combination of modifying the equipment, substituting gasket materials, and improving installation techniques has minimized the leakages.

Dust handling has also proven to be a major problem. The main components used in transporting the process fines are tubular drag conveyors, which have not performed up to expectations. The conveyors are unable to convey full-rated flow and have exhibited significant wear after relatively short operating times. These tubular drag conveyors are the facility's throughput bottleneck and the most frequent cause of unplanned shutdowns. Troubleshooting efforts have been aimed at improving the reliability of the existing equipment. A new fines conveying, disposal, cooling, and loadout system design effort was initiated. To continue process testing and improve reliability in light of the fines conveying bottleneck, the plant was converted to a single train operation in November.

Product Stability

The dried, cooled, and cleaned coal produced to date has exhibited spontaneous heating and combustion. When any significant mass of coal (more than 1 to 2 tons) is exposed to any significant air flow for periods ranging from 18 to 72 hours, the coal reaches temperatures necessary for spontaneous combustion or auto ignition to occur. Spontaneous heating of run-of-mine, low-rank coals has been a common problem but usually occurs after open air exposure periods of days or weeks, not hours. However, dried, low-rank coals have universally displayed spontaneous heating tendencies to a greater degree than raw, low-rank coals.

Troubleshooting this problem consisted primarily of testing process modifications, testing the application of additives to the coal both during and after the process, and considering additional process steps.

Product Dustiness

The product is basically dust free when it exits the processing facility due to numerous steps where the coal is fluidized in process gas or air, which removes the dust-size particles. The gas and air entrains any dust that has been produced since the last process step.

Typical to coal handling systems, each handling activity performed on the product coal after the coal leaves the process degrades the coal size and produces some dust. The fall into the product silos, which can be up to 90 feet, can be especially degrading to the coal. Quantifying dustiness of coals is difficult, but once the product coal has passed through the nine transfer points between the process and a rail car, the coal is visibly dustier than run-of-mine coal. The SynCoal® product is actually no dustier than the raw coal; the dust is just more fugitive. Because the SynCoal® product is dry, it does not have any inherent ability to adhere small particles to the coal surfaces. This allows any dust-size particles that are generated by handling to be released and become fugitive.

Troubleshooting efforts on this problem have just begun. These efforts consist of modifying transfer points to reduce impacts, examining methods of reducing degradation in the silos, and examining dust suppression options.

6.0 FUTURE WORK AREAS

Work continues on improving plant reliability and product stability. Once stable and maintainable systems have been obtained and the product is adequate for shipping, bulk production to produce test burn quantities will be the primary facility goal while continuing process testing and optimization.

APPENDIX A

Significant Accomplishments from Origination of Project to Date

SIGNIFICANT ACCOMPLISHMENTS (SINCE CONCEPT INCEPTION)

September	1981	Western Energy contracts Mountain States Energy to review LRC upgrading concept called the Greene process.
June	1982	Mountain States Energy built and tested a small batch processor in Butte, Montana.
December	1984	Initial patent application filed for the Greene process, December 1984.
November	1984	Initial operation of a 150 lb/hr continuous pilot plant modeling the Greene drying process at Montana Tech's Mineral Research Center in Butte, Montana.
November	1985	Added product cooling and cleaning capability to the pilot plant.
January	1986	Initiated process engineering for a demonstration-size Advanced Coal Conversion Process (ACCP) facility.
October	1986	Completed six month continuous operating test at the pilot plant with over 3,000 operating hours producing approximately 200 tons of SynCoal®.
October	1986	Western Energy submitted a Clean Coal I proposal to DOE for the ACCP Demonstration Project in Colstrip, Montana, October 18, 1986.
December	1986	Western Energy's Clean Coal proposal identified as an alternate selection by DOE.
February	1988	First U.S. patent issued February 16, 1988, No. 4, 725,337.
November	1987	Internal Revenue Service issued a private letter ruling designating the ACCP product as a "qualified fuel" under Section 29 of the IRS code, November 6, 1987.
May	1988	Western Energy submitted an updated proposal to DOE in response to the Clean Coal II solicitation, May 23, 1988.
May	1989	Second U.S. patent issued March 7, 1989, No. 4, 810,258.

**SIGNIFICANT ACCOMPLISHMENTS (cont'd.)
(SINCE CONCEPT INCEPTION)**

December	1988	Western Energy was selected by DOE to negotiate a Cooperative Agreement under the Clean Coal I program.
June	1990	Reach a negotiated agreement with DOE on the Cooperative Agreement, June 13, 1990.
September	1990	Signed Cooperative Agreement, after Congressional approval, September 13, 1990.
September	1990	Contracted project engineering with Stone & Webster Engineering Corporation, September 17, 1990.
December	1990	Formed Rosebud SynCoal Partnership, December 5, 1990.
December	1990	Started construction on the Colstrip site.
March	1991	Novated the Cooperative Agreement to the Rosebud SynCoal Partnership, March 25, 1991.
March	1991	Formal ground breaking ceremony in Colstrip, Montana, March 28, 1991.
December	1991	Initiated commissioning of the ACCP Demonstration Facility.
April	1992	Completed construction of the ACCP Demonstration Facility and entered Phase III, Demonstration Operation.
June	1992	Formal dedication ceremony for the ACCP Demonstration Project in Colstrip, Montana, June 25, 1992.
August	1992	Successfully tested product handling by shipping 40 tons of SynCoal® product to MPC's Colstrip Project, Unit 3 by truck.
October	1992	Completed 81 hour continuous coal run 10/2/92.
November	1992	Converted to a single process train operation.
December	1992	Produced a passivated product with a two-week storage life.

TECHNICAL PROGRESS REPORT

For the period:

January 1, 1992, through December 31, 1992

Prepared for:

Rosebud SynCoal Partnership
Advanced Coal Conversion Process Demonstration
Colstrip, Montana

DOE Contract
DE-FC22-90PC89664

Prepared by:

POWER Environmental Services, Inc.
Butte, Montana

December 1993

For submittal to:

United States Department of Energy
Pittsburgh Energy Technology Center

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APPENDIX A - Significant Accomplishments from Origination of Project to Date

1.0 INTRODUCTION AND PURPOSE

This report contains a description of the technical progress made on the Advanced Coal Conversion Process (ACCP) Demonstration Project from January 1, 1992, through December 31, 1992.

The ACCP Demonstration Project is a U.S. Department of Energy (DOE) Clean Coal Technology Project. The Cooperative Agreement defining this project is between DOE and the Rosebud SynCoal Partnership. In brief, Western Energy Company, which is a coal mining subsidiary of Entech, Inc., Montana Power Company's (MPC's) non-utility group in Colstrip, Montana, was the original proposer for the ACCP Demonstration Project and Cooperative Agreement participant. To further develop the ACCP technology, Entech created Western SynCoal Company. After the formation of the Rosebud SynCoal Partnership, Western Energy Company formally novated the Cooperative Agreement to the Rosebud SynCoal Partnership to facilitate continued participation in the Cooperative Agreement. The Rosebud SynCoal Partnership is a partnership between Western SynCoal Company and Scoria, Inc., a subsidiary of NRG Energy, Inc., Northern States Power's non-utility group.

This project demonstrates an advanced thermal coal drying process, coupled with physical cleaning techniques, that is designed to upgrade high-moisture, low-rank coals to a high-quality, low-sulfur fuel, registered as the SynCoal® process. The coal is processed through three stages (two heating stages followed by an inert cooling stage) of vibrating fluidized bed reactors that remove chemically bound water, carboxyl groups, and volatile sulfur compounds. After drying, the coal is put through a deep-bed stratifier cleaning process to separate the pyrite-rich ash from the coal.

The SynCoal® process enhances low-rank, western coals, usually with a moisture content of 25 to 55 percent, sulfur content of 0.5 to 1.5 percent, and heating value of 5,500 to 9,000 British thermal units per pound (Btu/lb), by producing a stable, upgraded, coal product with a moisture content as low as 1 percent, sulfur content as low as 0.3 percent, and heating value up to 12,000 Btu/lb.

The 45-ton-per-hour unit is located adjacent to a unit train loadout facility at Western Energy Company's Rosebud coal mine near Colstrip, Montana. The demonstration plant is sized at about one-tenth the projected throughput of a multiple processing train commercial facility. The demonstration drying and cooling equipment is currently near commercial size.

2.0 PROJECT PROGRESS

2.1 SIGNIFICANT ACCOMPLISHMENTS

Rosebud SynCoal Partnership's ACCP Demonstration Facility entered Phase III, Demonstration Operation, in April 1992 and has been operating in an extended startup mode since that time. As with any new developing technology, a number of unforeseen obstacles have been encountered; however, Rosebud SynCoal Partnership has instituted an aggressive program to overcome these obstacles. Significant accomplishments in the history of the SynCoal® process development are shown in Appendix A. Table 2.1 lists the significant accomplishments for 1992.

Table 2.1. Significant Accomplishments for 1992

Period	Significant Accomplishments
January 1992	<ul style="list-style-type: none"> Over 70 percent of the ACCP Demonstration Plant equipment was initially tested and operated. Conducted Cold Air Flow Testing in First Stage and Cooler Systems. Successfully modified vibrating reactor beds to correct for excessive deflection during coast down. Removed rotors from second-stage recirculation fan and shipped to Salt Lake City fabricator for rebuilding of rotor shafts.
February 1992	<ul style="list-style-type: none"> Solved vibration problems on 1st and 2nd stage fans. Successfully operated 90 percent of the ACCP Demonstration Plant equipment. Fixed hardware problems on Plant Control System. Completed initial refractory lining cure in the process gas furnace.
March 1992	<ul style="list-style-type: none"> Initiated dry coal production on March 23, 1992. Completed first 24-hour run on March 29, 1992. Successfully operated 98 percent of the ACCP Demonstration Plant equipment. Fixed hardware problems on Plant Control System. Completed final furnace refractory cure.
April 1992	<ul style="list-style-type: none"> Demonstrated coal flow at 30-40 tons per hour. Successfully operated all ACCP Demonstration Plant equipment. Uncleaned SynCoal® product analyzed as 1.9 percent moisture and 11,370 Btu/lb. Identified problems with explosion panels, rotary airlocks, drag conveyors, and coal fines in cooling tower water.
May 1992	<ul style="list-style-type: none"> Produced 960 tons of cleaned SynCoal® product and sent to product silo - 3-5 percent moisture, 9 percent ash, 0.5 percent, and 11,500+ Btu/lb. Identified spontaneous heating problem with the SynCoal® product. Completed first continuous 24-hour clean SynCoal® production run on May 28, 1992.
June 1992	<ul style="list-style-type: none"> Successfully operated all ACCP Demonstration Plant equipment. Produced 670 tons of clean product during 95 hours of operation in three separate test runs. Shipped 214 tons of SynCoal® to MPC's J.E. Corette Plant by rail on June 17, 1992. Official dedication of the ACCP Demonstration Project on June 25, 1992. Identified problem with dustiness of SynCoal® product. Identified need for an alternate fines disposal system.

Table 2.1. Significant Accomplishments for 1992 (cont'd.)

July 1992	<ul style="list-style-type: none"> • Successfully executed process tests D9201 and D9202. • Initiated pilot plant testing to assist with spontaneous combustion issue. • Installed process fines slurry disposal system.
August 1992	<ul style="list-style-type: none"> • Initiated truck deliveries to Colstrip Units 3 and 4. • Continued pilot plant testing. • Provided a full week of operator training to all operators. • Continued process testing, conducting test D9203.
September 1992	<ul style="list-style-type: none"> • Identified internal process gas bypass problem in dryer reactors. • Continued process testing, conducting tests D9204, D9205, and D9206. • Shipped 1,672 tons of SynCoal® to MPC's J.E. Corette Plant. • Successfully operated the process furnace below 2 percent excess oxygen.
October 1992	<ul style="list-style-type: none"> • Completed 81 hour continuous coal run 10/2/92. • Completed winterization outage. • Trucked 329 tons of SynCoal® to MPC's J.E. Corette Plant. • Trucked 194 tons of SynCoal® to Colstrip Units 3 and 4. • Discovered dryer/cooler reactor bearing factory flaws. • Installed bin inerting system on T894. • Repaired/replaced main process heat exchanger expansion joint and process gas fan shaft seals. • Drilled out cooler reactor plenum holes.
November 1992	<ul style="list-style-type: none"> • Trucked 929 tons of SynCoal® to MPC's J.E. Corette Plant. • Trucked 1,457 tons of SynCoal® to Colstrip Units 3 and 4. • Continued process testing to reduce spontaneous combustion tendency. • Converted to a single process train operation. • Identified process fines slurry capacity limitation. • Met with United States Bureau of Mines and DOE researchers about coal oxidation studies.
December 1992	<ul style="list-style-type: none"> • Trucked 317 tons of SynCoal® to Colstrip Units 3 and 4. • Continued process testing to reduce spontaneous combustion tendency. • Produced a passivated product with a two-week storage life. • Identified design problem with process gas ductwork expansion joints.

2.2 PROJECT PROGRESS SUMMARY

Original design and construction work is complete. All ACCP Demonstration Project equipment and systems are operational with the exception of the processed fines briquetter system. However, during the Fourth Quarter, the product's instability and limited plant reliability have restricted the facility's operating factor to about 27.2 percent and raw coal feed rate to less than 10 percent of nominal design capacity. To date, about 28,686 tons of raw coal have been fed to the process, producing about 14,000 tons of uncleaned and cleaned product. A little over 5,566 tons have been test shipped, showing that product dustiness is an issue that needs to be addressed.

Modifications and major maintenance work during the reporting period focused on:

- installing first-stage PRS screw conveyor;
- installing fan insulation;
- starting pump house installation for cold weather;
- installing a mass spectrometer for process gas analysis;
- installing an automatic knife and divert gates on the process surge bins;
- installing a larger cooling water line to the cooling tower for increased quench cooling capacity;
- installing an uninterruptible power supply (UPS);
- installing new Flights on C-15;
- installing liquid carbon dioxide storage and vaporization system for testing;
- upsizing cooler bed holes for increased cooling gas flow;
- replacing the main process heat exchanger expansion joint;
- upgrading fan shaft seal to limit oxygen infiltration into the process gas;
- fabricating test fixtures for barrel tests (silo simulation tests);
- replacing every bearing on the drying and cooling vibro-fluidized beds, due to a factory flaw;
- modifying the dust conveying and handling equipment; and
- modifying temporary slurry disposal system.

During the Third Quarter of 1992, modifications and major maintenance work involved:

- repairing second-stage vibratory fluid bed reactors;
- sealing the process gas heat exchanger;
- modifying the processed fines conveying equipment; and
- installing temporary slurry fines disposal system.

During Second Quarter of 1992, modifications and major maintenance work focused on:

- upgrading the process rotary air locks;
- rebuilding the dryer hood seals;
- improving the vibratory fluidized beds;
- modifying the processed fines conveying equipment;
- rewriting operator graphic interface programs;
- replacing and upgrading the explosion relief panels; and
- replacing prematurely worn drag conveyor flights.

During the First Quarter of 1992, modifications and major maintenance work focused on:

- rebuilding process gas fan foundation pedestals;
- rebuilding air compressor foundations;
- replacing rotor shafts on second-stage fans;
- removing and redesigning shaft seals on process gas fans;
- rewriting operator graphic interface programs; and
- replacing, redesigning, and upgrading the explosion relief panels.

The product produced to date has been exceptionally close to the design basis product from a chemical standpoint. The typical product analyses are shown in Table 2.2.

Table 2.2. ACCP Quarterly Analysis Summary

	TM	PA	PS	HHV	SO ₂
First Quarter Product					
None					
Second Quarter Product					
Average	3.47	9.14	0.53	11,615	0.91
Standard Deviation	0.77	0.99	0.08	144	0.16
Min.	2.28	8.34	0.45	11,240	0.78
Max.	4.93	12.81	0.87	11,857	1.55
Third Quarter Product					
Average	1.69	9.61	0.57	11,913	0.96
Standard Deviation	0.36	0.75	0.04	136	0.07
Min.	1.18	8.49	0.52	11,719	0.86
Max.	2.30	11.41	0.64	12,149	1.09
Fourth Quarter Product					
Average	2.07	9.51	0.53	11,907	0.88
Standard Deviation	0.35	0.38	0.05	74	0.09
Min.	1.17	8.30	0.44	11,676	0.74
Max.	3.26	10.17	0.67	12,116	1.13
TM - % Total Moisture PA - % Ash PS - % Sulfur HHV - Btu/lb. SO ₂ - lbs. of SO ₂ /MMBtu					

3.0 PROCESS DESCRIPTION

In general, the ACCP is a drying and conversion process that uses combustion products and superheated steam as fluidizing gas in vibrating fluidized beds. Two fluidized stages are used to heat and dry the coal, and one water spray stage followed by one fluidized stage is used to cool the coal. Other systems that service and assist the coal conversion system include:

- Coal Conversion;
- Coal Cleaning;
- Product Handling;
- Raw Coal Handling;
- Emission Control;
- Heat Plant;
- Heat Rejection; and
- Utility and Ancillary.

The central processes are depicted in Figure 3.1 on the proceeding page. The following discusses plant design aspects and expected results. Work to date has not verified these aspects or results.

Coal Conversion

Coal conversion is performed in two parallel processing trains. Each train consists of two, 5-foot-wide by 30-foot-long, vibratory fluidized bed dryer/reactors in series, followed by a water spray section, and a 5-foot-wide by 25-foot-long, vibratory cooler. Each processing train is fed 1,139 pounds per minute of 2-by-1/2 inch coal.

In the first-stage dryer/reactors, the coal is heated using recirculated combustion gases, removing primarily surface water from the coal. The coal exits the first-stage dryer/reactors at a temperature slightly above that required to evaporate water. After the coal exits the first-stage dryer/reactor, it is gravity fed to the second-stage dryer/reactors, which further heats the coal using a recirculating gas stream, removing water trapped in the pore structure of the coal and promoting decarboxylation. The water, which makes up the superheated steam used in the second stage, is actually produced from the coal itself. Particle shrinkage that occurs in the second stage liberates ash minerals and passes on a unique cleaning characteristic to the coal.

As the coal exits the second-stage dryer/reactors, it falls through vertical coolers where process water is sprayed onto the coal to reduce the temperature. The water vaporized during this operation is drawn back into the second-stage dryer/reactors. After water quenching, the coal enters the vibratory coolers where the coal is contacted by cool inert gas. The coal exits the vibratory cooler(s) at less than 150°F and enters the coal cleaning system. The gas that exits the vibratory coolers is cooled by water sprays in contact coolers prior to returning to the vibratory coolers.

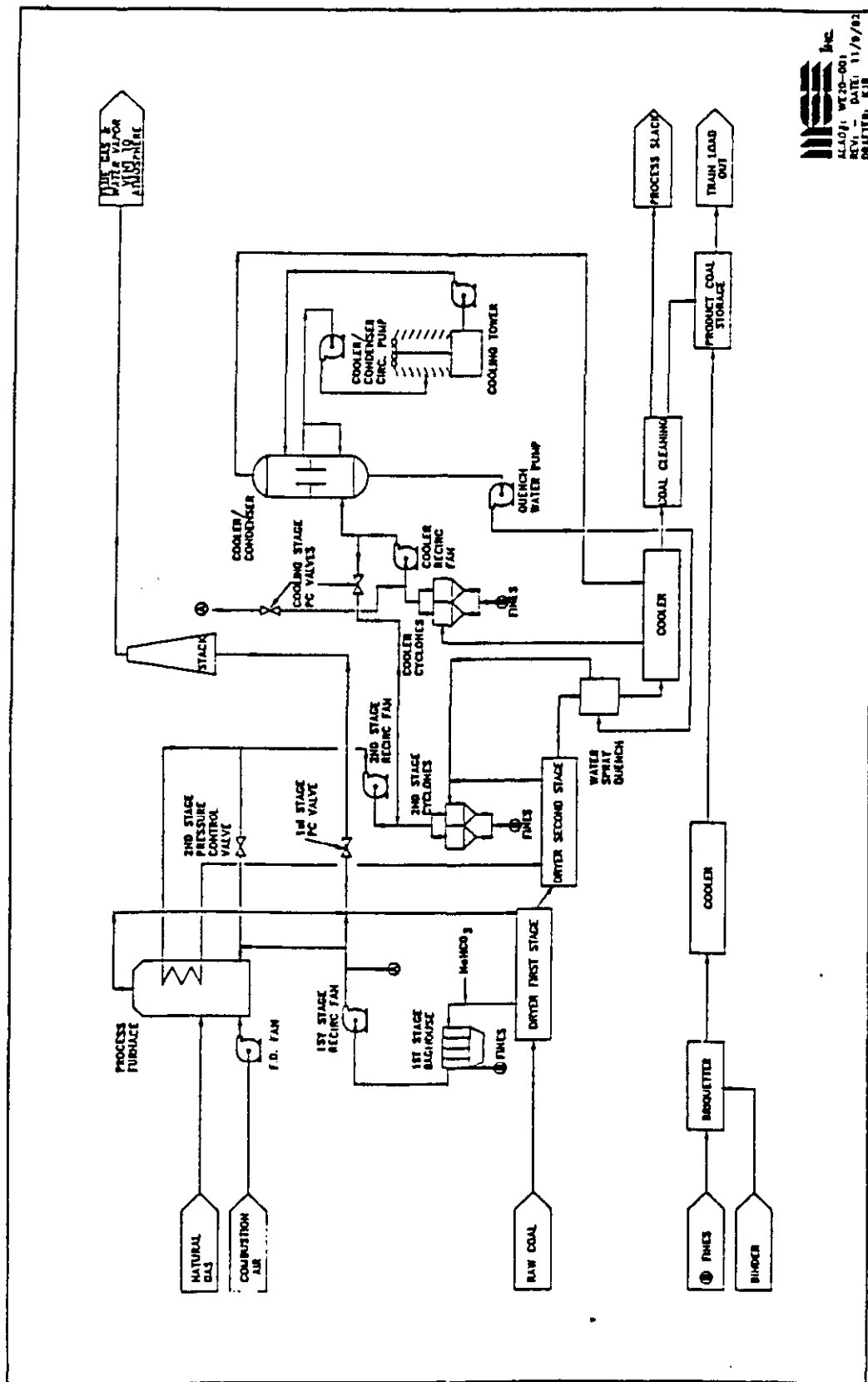


Figure 3.1 Central Processes

Three interrelated recirculating gas streams are used in the coal conversion system; one each for the dryer/reactors and one for the vibratory coolers.

Gases enter the process from either the natural gas-fired process furnace or the coal itself. Combustion gases from the furnace are used in the first-stage dryer/reactors after transferring some heat to the second-stage gas stream. The second-stage gas stream is composed mainly of superheated steam, which is heated by the furnace combustion gases in the heat exchanger. The cooler gas stream is made up of cooled furnace combustion gases that have been routed through the cooler loop.

A gas route is available from the cooler gas loop to the second-stage dryer/reactor loop. Gas may also enter the first-stage dryer/reactor loop from the second-stage loop (termed make-gas) without directly entering the first-stage dryer/reactor loop; rather, the make-gas is used as an additional fuel source in the process furnace. The final gas route is the exhaust stream from the first-stage loop to the atmosphere.

Gas exchange from one loop to another is governed by pressure control on each loop, and after startup, will be minimal from the first-stage loop to the cooler loop and from the cooler loop to the second-stage loop. Gas exchange from the second-stage loop to first-stage loop (through the process furnace) may be substantial since the water vapor and hydrocarbons driven from the coal in the second-stage dryer/reactors must leave the loop to maintain a steady state.

In each gas loop, particulate removal devices that remove dust from the gas streams protect the fans. The control emissions are upstream of the fans.

Coal Cleaning

The coal entering the cleaning system is screened into four size fractions: plus 1/2 inch, 1/2 by 1/4 inch, 1/4 inch by 6 mesh, and minus 6 mesh. These streams are fed in parallel to four, deep-bed stratifiers (stoners) where a rough specific gravity separation is made using fluidizing air and a vibratory conveying action. The light streams from the stoners are sent to the product conveyor; the heavy streams from all but the minus 6 mesh stream are sent to fluidized bed separators. The heavy fraction of the minus 6 mesh stream goes directly to the waste conveyor. The fluidized bed separators, again using air and vibration to effect a gravity separation, each split the coal into light and heavy fractions. The light stream is considered product; the heavy or waste stream is sent to a 300-ton, storage bin to await transport to an off-site user or alternately back to a mined out pit disposal site. The dried, cooled, and cleaned product from coal cleaning enters the product handling system.

Product Handling

Product handling consists of the equipment necessary to convey the clean product coal into two, 6,000-ton, concrete silos and to allow train loading with the existing loadout system.

Raw Coal Handling

Raw coal from the existing stockpile is screened to provide 2-by-1/2 inch feed for the ACCP process. Coal rejected by the screening operation is conveyed back to the active stockpile. Properly sized coal is conveyed to a 1,000-ton, raw coal, storage bin which feeds the process facility.

Emission Control

Sulfur dioxide emission control philosophy is based on injecting dry sorbents into the ductwork to minimize the release of sulfur dioxide to the atmosphere. Sorbents, such as trona or sodium bicarbonate, are injected into the first-stage dryer gas stream as it leaves the first-stage dryers to maximize the potential for sulfur dioxide removal while minimizing reagent usage. The sorbents, having reacted with sulfur dioxide, are removed from the gas streams in the particulate removal systems. A 60-percent reduction in sulfur dioxide emissions should be realized.

The coal cleaning area fugitive dust is controlled by placing hoods over the sources of fugitive dust conveying the dust laden air to fabric filter(s). The bag filters can remove 99.99 percent of the coal dust from the air before discharge. All coal fines will report to a briquetter and ultimately the product stream.

Heat Plant

The heat required to process the coal is provided by a natural gas-fired process furnace, which uses process make-gas from coal conversion as fuel. This system is sized to provide a heat release rate of 74 MM Btu/hr. Process gas enters the furnace and is heated by radiation and convection from the burning fuel.

Heat Rejection

Most heat rejection from the ACCP is accomplished by releasing water and flue gas into the atmosphere through an exhaust stack. The stack design allows for vapor release at an elevation great enough that, when coupled with the vertical velocity resulting from a forced draft fan, dissipation of the gases will be maximized. Heat removed from the coal in the coolers is rejected using an atmospheric-induced, draft cooling tower.

Utility and Ancillary Systems

The coal fines that are collected in the conversion, cleaning, and material handling systems are gathered and conveyed to a surge bin. The coal fines are then agglomerated and returned to the product stream.

Inert gas is provided by cooling and drying combustion flue gases. This gas, primarily nitrogen and carbon dioxide, is used principally for baghouse pulse and for make-gas in the cooler loop.

The common facilities for the ACCP include a plant and instrument air system, a fire protection system, and a fuel gas distribution system.

The power distribution system includes a 15 kV service; a 15 kV/5 kV transformer; a 5 kV motor control center; two, 5 kV/480 V transformers; a 480 V load distribution center; and a 480 V motor control center.

The process is fully automated, including dual control stations, dual programmable logic controllers, and distributed plant control and data acquisition hardware.

3.1 ORIGINAL EQUIPMENT

The originally designed and installed major equipment for the ACCP Demonstration Facility is shown in Table 3.1.

Table 3.1. Advanced Coal Conversion Process Major Plant Equipment

System Description	Equipment Vendor	Type
Coal Dryers/Coolers	Carrier Vibrating Equipment, Inc.	PE
Belt Conveyors	Willis & Paul Group	MH
Bucket Elevators	FMC Corporation	MH
Coal Cleaning Equipment	Triple S Dynamics, Inc.	CC
Coal Screens	Hewitt Robbins Corporation	MH
Loading Spouts	Midwest International	MH
Dust Agglomerator	Royal Oak Enterprises, Inc.	DH
Silo Mass Flow Gates	SEI Engineers, Inc.	MH
Vibrating Bin Dischargers	Carman Industries, Inc.	MH
Vibrating Feeder	Kinergy Corporation	MH
Drag Conveyor	Dynamet	DH
Process Gas Heater	G.C. Broach Company	PE
Direct Contact Cooler	CMI-Schneible Company	PE
Particulate Removal System	Air-Cure Howden	EC
Dust Collectors	Air Cure Environmental, Inc.	EC
Air Compressors/Dryers	Colorado Compressor, Inc.	CF
Diesel Fire Pumps	Peerless Pump Company	CF
Forced Draft Fans	Buffalo Forge Company	PE
Pumps	Dresser Pump Division Dresser Industries, Inc.	PE
Electrical Equipment-4160	Toshiba/Houston International Corporation	CF
Electrical Equipment-LDC	Powell Electric Manufacturing Company	CF
Electrical Equipment-480v MCC	Siemens Energy & Automation, Inc.	CF
Main Transformer	ABB Power T&D Company	CF
Control Panels	Utility Control & Equipment Corporation	CF
Control Valves	Applied Control Equipment	CF
Plant Control System	General Electric Supply Company	CF
Cooling Tower	The Marley Cooling Tower Company	PE
Dampers	Effox, Inc.	PE
Dry Sorbent Injec. System	Natech Resources, Inc.	EC
Expansion Joints	Flexonics, Inc.	PE
MH - Materials Handling PE - Process Equipment EC - Emissions Control CF - Common Facilities CC - Coal Cleaning • DH - Dust Handling		

3.2 MODIFIED OR REPLACED EQUIPMENT

Facility modifications and maintenance work to date have been dedicated to obtaining an operational facility.

The modifications to the original system performed for the year to date (with modifications during this reporting period shown in bold print) involved:

Fourth Quarter 1992:

Instrumentation:

- installing a mass spectrometer for process gas analysis;

General:

- starting pump house installation for cold weather,
- installing an automatic knife and divert gates on the process surge bins, and
- installing liquid carbon dioxide storage and vaporization system for testing;

Cooling Tower:

- installing a larger cooling water line to the cooling tower for increased quench cooling capacity;

Electrical Equipment:

- installing an uninterruptible power supply (UPS);

Process Gas Heater:

- replacing the main process heat exchanger expansion joint;

Forced Draft Fans:

- upgrading fan shaft seal to limit oxygen infiltration into the process gas, and
- installing fan insulation;

Dryers/Coolers:

- replacing every bearing on the drying and cooling vibro-fluidized beds, due to a factory flaw, and
- upsizing cooler bed holes for increased cooling gas flow; and

Draw Conveyors/Screw Conveyors:

- installing new Flights on C-15,
- modifying the dust conveying and handling equipment,
- modifying temporary slurry disposal system, and
- installing first stage PRS screw conveyor.

Third Quarter 1992:**Coal Dryers/Coolers:**

- repairing second-stage vibratory fluid bed reactors;

Process Gas Heater:

- sealing the process gas heat exchanger; and

Drag Conveyors:

- modifying the processed fines conveying equipment, and
- installing temporary slurry fines disposal system.

Second Quarter 1992:**Coal Dryers/Coolers:**

- upgrading process rotary air locks - increased from 2 to 5 hp and adding reversing starters,
- rebuilding dryer hood seals - fixed seal design problems and seal leaking joints, and
- improving the vibratory fluidized beds - eliminate process gas bypass/welding out seams, etc.;

Drag Conveyor:

- modifying processed fines conveying equipment to reduce required throughput on drag conveyors by adding a first stage screw conveyor and straightening and shortening tubular drag conveyors;

Plant Control System:

- continued rewriting operator graphic interface programs; and

General:

- replacing and upgrading explosion relief panels - went through design/trials.

First Quarter 1992:**Air Compressors/Dryers:**

- rebuilding air compressor foundations;

Forced Draft Fans:

- rebuilding foundation pedestals for process gas fans,
- replacing rotor shafts on second-stage fans, and
- removing and redesigning shaft seals on process gas fans.

Table 3.2 shows the equipment that has either been modified or replaced. If replacement was required, the new equipment is listed.

Figure 3.2 shows the modified Process Flow Diagram, including the temporary slurry disposal to the slurry pit.

Table 3.2. Advanced Coal Conversion Process Modified Major Plant Equipment

System Description	Equipment Vendor	Type	Modified No/Yes	Replaced With
Coal Dryers/Coolers	Carrier Vibrating Equipment, Inc.	PE	/✓	
Belt Conveyors	Willis & Paul Group	MH	/	
Bucket Elevators	FMC Corporation	MH	/	
Coal Cleaning Equipment	Triple S Dynamics, Inc.	CC	/	
Coal Screens	Hewitt Robbins Corporation	MH	/	
Loading Spouts	Midwest International	MH	/	
Dust Agglomerator	Royal Oak Enterprises, Inc.	DH	/	
Silo Mass Flow Gates	SEI Engineers, Inc.	MH	/	
Vibrating Bin Dischargers	Carman Industries, Inc.	MH	/	
Vibrating Feeder	Kinergy Corporation	MH	/	
Drag Conveyor	Dynamet	DH	/✓	
Screw Conveyor	Farm Aid Equipment Company	MH	Added	
Process Gas Heater	G.C. Broach Company	PE	/✓	
Direct Contact Cooler	CMI-Schneible Company	PE	/✓	
Particulate Removal System	Air-Cure Howden	EC	/	
Dust Collectors	Air Cure Environmental	EC	/	
Air Compressors/Dryers	Colorado Compressor, Inc.	CF	/✓	
Diesel Fire Pumps	Peerless Pump Company	CF	/	
Forced Draft Fans	Buffalo Forge Company	PE	/✓	
Pumps	Dresser Pump Division Dresser Industries, Inc.	PE	/	
Electrical Equipment-4160	Toshiba/Houston International Corp.	CF	/	
Electrical Equipment-LDC	Powell Electric Manufacturing Corp.	CF	/	
Electrical Equipment-480v MCC	Siemens Energy & Automation, Inc.	CF	/✓	
Main Transformer	ABB Power T&D Company	CF	/	
Control Panels	Utility Control & Equipment Corp.	CF	/	
Control Valves	Applied Control Equipment	CF	/	
Plant Control System	General Electric Supply Company	CF	/✓	
Cooling Tower	The Marley Cooling Tower Company	PE	/✓	
Dampers	Effox, Inc.	PE	/	
Dry Sorbent Injec. System	Natech Resources, Inc.	EC	/	
Expansion Joints	Flexonics, Inc.	PE	/✓	
MH - Materials Handling PE - Process Equipment EC - Emissions Control CF - Common Facilities CC - Coal Cleaning DH - Dust Handling				

Process Flow Diagram

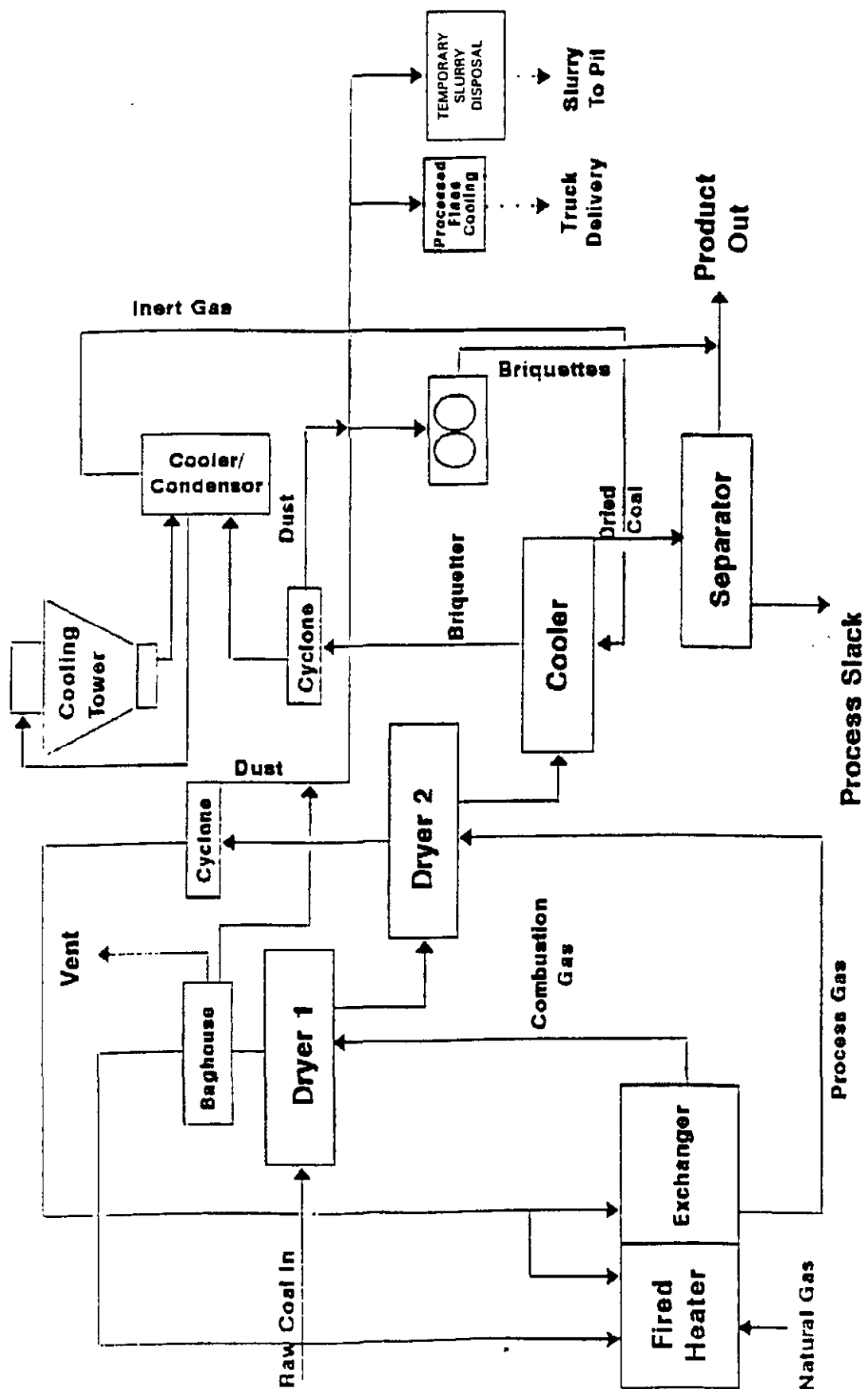


Figure 3.2 Modified Process Flow Diagram

Flowdgm

4.0 TECHNICAL PROGRESS

4.1 FACILITY OPERATIONS/PLANT PRODUCTION

Table 4.1 summarizes the ACCP Demonstration Facility's operations and plant production levels that have been achieved through the reporting period and the facility's lifetime to date. Table 4.2 lists the ACCP Demonstration Facility's monthly shipments of the SynCoal® product.

The difference between the feed coal and the amount of clean coal produced is due to water loss; samples removed for analysis; and process fines, which are captured in the particulate removal system and cleaning system dust collector and returned to the mine for disposal. Very little dust is actually lost to the atmosphere.

Approximately 1,300 tons of product coal were shipped to MPC's Corette Power Plant in Billings, Montana, and approximately 2,000 tons of product coal were shipped to MPC's Colstrip Project, Units 3 and 4 during the Fourth Quarter of 1992.

4.2 FACILITY TESTING

Facility modifications and maintenance to date have been dedicated to obtaining a more reliable facility, therefore, focusing on modifying the fines conveying equipment, process surge bins, slurry disposal process, duct expansion joints, fan bearings, first stage screw conveyor, and fan insulation installation; increasing cooling tower capacity; and installing liquid CO₂ storage and vaporization system.

Testing during October included testing at the pilot plant in Butte, Montana. The pilot tests were run to determine the effects of high dryer outlet temperatures and higher cooling gas carbon dioxide concentrations on product quality. Barrel tests were also performed on pilot plant product to make an accurate determination of make gas.

Testing during the remainder of the Fourth Quarter mainly involved passivation testing to inhibit the spontaneous combustion tendency of the product. Test results have shown some success with some passivated product having a storage life of two (2) weeks.

Facility testing to date has focused on understanding and controlling product stability. Six tests have been performed at the facility during the reporting period, and one, pilot-plant test was performed in Butte. These tests are summarized in Tables 4.3 and 4.4, respectively.

Table 4.1. ACCP Demonstration Project Monthly Operating Statistics

Month	Operating Hours	Operating Factor	Non-Scheduled Hours	Schedule Factor	Scheduled Operating Factor	Feed Tons	Ave. Feedrate	Feed Capacity Factor	Total Shipments	Ending Silo Inventory	Comments
Mar. '92	33	4.4%	0	100.0%	4.4%	700	21.21	1.9%	181	0	Est Feed Tons/Hours
Apr. '92	47	6.5%	288	60.0%	10.9%	411	8.74	1.1%	212	0	Est Feed Tons/Hours
May '92	89	12.0%	366	50.8%	23.5%	2,757	30.98	7.4%	0	0	Silo Heating Problem Encountered
Jun. '92	95	13.2%	225	68.8%	19.2%	2,496	26.27	6.7%	214	0	Dedication 6/25, Corette shipment 6/17
2nd Quarter 1992 Summary	231	10.6%	879	59.8%	17.7%	5,664	24.52	5.0%	426	0	
July '92	53	7.1%	624	16.1%	44.2%	1,436	27.09	3.8%	0	0	Start Formal Process Testing
Aug. '92	124	16.7%	432	41.9%	39.7%	1,860	15.00	5.0%	61	0	Operator Training/Production Runs
Sept. '92	315	43.9%	252	65.0%	57.3%	8,725	27.70	23.3%	1,672	0	Corette Truck Shipments
3rd Quarter 1992 Summary	492	22.3%	1,308	40.8%	54.7%	12,021	24.43	10.7%	1,733	0	
Oct. '92	97	13.0%	480	35.5%	36.7%	2,292	23.63	6.1%	523	0	Winterization Outage
Nov. '92	420	58.3%	139	80.7%	72.3%	6,946	16.54	18.5%	2,386	0	Dust Conveying Problems/Slurry Freezing
Dec. '92	84	11.3%	332	55.4%	20.4%	1,063	12.65	2.8%	317	0	Expansion Joint Failure/Major Outage
4th Quarter 1992 Summary	601	27.2%	951	56.9%	47.8%	10,301	17.14	9.2%	3,226	0	
Totals	1,357	18.5%	3,138	57.3%	32.3%	28,686	21.14		5,566	0	

Table 4.2. ACCP Demonstration Project Monthly Shipments

Month	Total Shipments	Shipments by Customer (tons)		
		MPC Corette	Units 3 & 4	CELP Montana 1
Mar. '92	by truck	0	0	181
Apr. '92	by truck	0	0	212
May '92	0	0	0	0
Jun. '92	2.5 cars	214	0	0
2nd Quarter 1992 Summary		214	0	212
July '92	0	0	0	0
Aug. '92	by truck	0	61	0
Sept. '92	by rail	1,672	0	0
3rd Quarter 1992 Summary		1,672	61	0
Oct. '92	by truck	329	194	0
Nov. '92	by truck	929	1,457	0
Dec. '92	by truck	0	317	0
4th Quarter 1992 Summary		1,258	1,968	0
Totals		3,144	2,029	393

Table 4.3. ACCP Demonstration Plant Testing Summary

Test Number	Test Description	Test Dates
9206-B	Determined particle degradation and dryer residence times under cold flow conditions.	10/26/92 - 10/27/92
9208	Explored various spontaneous heating mitigation treatments.	10/29/92 - 11/5/92
9209	Determined the drag conveyors and slurry system for dust handling are undersized.	11/10/92 - 11/19/92
9210	Determined the effects of purging the storage bin with CO ₂ before dumping the coal for enhanced product stability.	12/19/92 - 12/27/92
9210-B	Determined processed coal passivated with CO ₂ lasts three times longer than untreated product.	12/10/92
9216	Explored blend testing to isolate the spontaneous heating variables using 55-gallon barrels.	11/17/92 - 11/20/92

As part of the initial production period, baseline testing of the process is being performed. Compliance monitoring of the particulate removal systems still remains to be completed.

Table 4.4. ACCP Pilot Plant Testing Summary

Test Number	Test Description	Test Dates
P92C	Determined the effects of high dryer outlet temperatures and higher cooling gas carbon dioxide concentrations on product quality.	10/15/92 - 10/25/92

4.3 PRODUCT TESTING

The product produced to date has been exceptionally close to the design basis product from a chemical standpoint but has not been acceptable from a physical standpoint due to instability (spontaneous heating) and dustiness. The coal appears to continue to heat after processing. Work with the United States Bureau of Mines, DOE, and independent consultants has led to the conclusion that product stability will be obtained by focusing on one or more of the following variables:

- product rehydration (amount and time);
- product oxidation (quantity and time);
- product cooling (amount and time); and
- product pacification.

Product analyses during the reporting period are shown in Table 4.5.

Table 4.5. ACCP Quality Analyses for 1992 Annual Report

SAMPID	SAMPDATE	TONNAGE	TM	PA	PS	HHV	SO ₂	COMM
SECOND QUARTER, 1992								
798	05/29/92	1	24.08	8.53	1.11	8.881	2.51	C-1-05, 07-20, Topsize = +1.25"
806	05/30/92	1	24.17	7.57	0.83	8.028	1.40	W-78 RAW, 05-30, Topsize = +3/4"
881	08/11/92	1	23.23	7.28	0.49	8.979	1.02	C-1-05 07-55, Topsize = +1 1/2 in.
858	08/11/92	1	23.30	7.87	0.75	8.139	1.84	C-1-5, 05-30/08-30, TOPSIZE = +1.50 in.
880	08/11/92	1	21.88	9.95	0.88	8.987	1.47	C-1-05 22-55, Topsize = +1 1/2 in.
873	08/12/92	1	22.87	8.98	0.86	9.044	1.90	C-1-05 composite, Topsize=1.5 in.
918	08/19/92	1	23.53	9.13	0.75	8.974	1.87	C-1-05, Topsize = +1 1/2 in.
908	08/19/92	1	23.55	8.65	0.65	8.953	1.45	C-1-05, 02-15, Topsize = +1 1/2 in.
939	08/21/92	1	23.43	8.20	0.88	9.074	1.80	C-5 RAW, 11-30.
AVERAGE			23.34	8.57	0.75	9.004	1.88	
STANDARD DEVIATION			0.85	0.65	0.17	.75	0.38	
MIN			21.88	7.28	0.48	8.881	1.02	
MAX			24.17	9.95	1.11	9.139	2.51	

LEGEND	
TM	% Total Moisture
PA	% Ash
PS	% Sulfur
HHV	Btu/lb.
SO ₂	lbs. of SO ₂ /MMBtu
COMM	Comments

Table 4.5. ACCP Quality Analyses for 1992 Annual Report (cont'd.)

PRODUCT											
SAMPID	SAMPDATE	TONNAGE	TM	PA	PS	PHV	SO2	COMM			
795	05/28/92	1	4.47	9.00	0.52	11.552	0.90	C 9.11, 18.20 Topsize = + 3/8"			
797	05/28/92	1	3.22	8.80	0.50	11.728	0.85	C 8. 07.00 Topsize = + No. 4 No air dry Reported value			
786	05/28/92	1	4.78	9.47	0.49	11.387	0.88	C 11.02.00 TOPSIZE = + 1/4"			
787	05/28/92	1	3.14	9.22	0.48	11.695	0.82	C 8. 07.00 Air dried This value not reported			
783	05/28/92	1	3.32	8.34	0.54	11.748	0.92	C 9.08.02.30 Topsize = + 1/4"			
797	05/29/92	1	4.93	9.21	0.53	11.455	0.93	C 9.08.05.20 Topsize = 1/2"			
807	05/30/92	1	3.62	9.77	0.54	11.569	0.93	C 9.08.01.30 Topsize = + 1/4"			
805	05/30/92	1	3.49	8.86	0.53	11.674	0.91	C 9.08.05.30 Topsize = 3/8"			
85	06/11/92	1	2.82	8.63	0.48	11.823	0.81	C 9.8.11.00 Topsize = 3/8 in.			
860	06/11/92	1	3.82	8.45	0.45	11.575	0.78	C 9.08			
886	06/11/92	1	2.60	8.68	0.51	11.662	0.87	C 8.08.23.10			
859	06/11/92	1	3.33	8.58	0.47	11.888	0.80	11.00 60 MESH REPEATER			
895	06/11/92	1	3.73	8.94	0.51	11.512	0.89	60 MESH REPEATER			
895	06/11/92	1	2.59	8.82	0.53	11.683	0.91	C 9.08.08.30			
874	06/12/92	1	3.69	8.75	0.51	11.608	0.88	C 9.08 Composite Topsize = 3/8 in.			
907	06/16/92	1	2.88	10.25	0.52	11.850	0.89	C809.02.45 Topsize = 3/8 in			
912	06/16/92	1	4.60	8.40	0.51	11.558	0.88	C 9.08.10.15 Topsize = 1/4 in			
936	06/21/92	1	2.54	8.52	0.51	11.857	0.88	C 8 Prod. 11.30.			
938	06/21/92	1	2.28	12.81	0.87	11.240	1.55	T85 loadout, 20.00			
AVERAGE			3.47	8.14	0.53	11.615	0.81				
STANDARD DEVIATION			0.77	0.99	0.08	1.44	0.16				
MIN			2.28	8.34	0.45	11.240	0.78				
MAX			4.93	12.81	0.87	11.857	1.55				
THIRD QUARTER, 1992											
1228	09/03/92	1	1.88	9.92	0.60	11.828	1.01	C 13. 13.00 TRUCK TO CORETTE			
1259	09/08/92	1	2.30	9.40	0.64	11.728	1.08	C13.500°F. 1800			
1281	09/09/92	1	1.60	8.89	0.58	11.889	0.93	C13.700°F. 11.30			
1280	09/09/92	1	2.14	9.28	0.83	11.788	1.07	C13.800°F. 02.00			
	09/14/92		1.38	11.41	0.60	11.718	1.02				
	09/16/92		1.77	9.78	0.57	11.848	0.98				
	09/17/92		2.22	8.49	0.52	11.905	0.87				
	09/23/92		1.27	8.41	0.57	11.993	0.95				
	09/25/92		1.85	9.42	0.57	11.898	0.88				
1385	09/28/92	1	1.18	10.14	0.55	12.148	0.81	C 8. 20.10			
1383	09/29/92	1	1.42	10.33	0.52	12.090	0.88	C 8. 18.10			
	09/30/92		1.41	8.84	0.53	12.047	0.89				
AVERAGE			1.69	9.81	0.57	11.913	0.88				
STANDARD DEVIATION			0.38	0.75	0.04	1.38	0.07				
MIN			1.18	8.49	0.52	11.718	0.88				
MAX			2.30	11.41	0.64	12.149	1.08				
FOURTH QUARTER, 1992											
1387	10/01/92	1	1.17	9.52	0.53	12.118	0.87	C 8.08.40.			
	10/01/92		1.37	8.69	0.56	11.982	0.83				
1538	10/31/92	1	2.20	9.54	0.49	11.863	0.83	Small sample No reference kept.			
	10/31/92		1.82	9.45	0.48	11.878	0.77				
1539	11/01/92	1	2.42	8.95	0.47	11.845	0.78				
	11/01/92		2.07	9.20	0.44	11.850	0.74				
	11/05/92		1.82	9.45	0.46	11.878	0.77				
1593	11/08/92	1	2.50	9.01	0.52	11.889	0.87				
	11/08/92		2.07	9.20	0.44	11.850	0.74				
	11/08/92		1.87	9.07	0.48	11.881	0.80				
	11/08/92		2.29	8.89	0.48	11.921	0.81				
	11/10/92	1	2.13	8.11	0.52	11.958	0.87				
1584	11/10/92	1	1.83	8.11	0.50	11.971	0.84				

Table 4.5. ACCP Quality Analyses for 1992 Annual Report (cont'd.)

1602	11/11/92	1	2.10	9.06	0.48	11,926	0.80	
	11/11/92		1.87	9.07	0.48	11,961	0.80	
	11/13/92		2.29	8.89	0.48	11,921	0.81	
1633	11/17/92	1	2.10	8.80	0.49	11,988	0.82	
	11/17/92		1.98	8.87	0.47	12,026	0.78	
1644	11/18/92	1	2.23	9.67	0.48	11,872	0.81	
	11/18/92		1.99	9.81	0.49	11,910	0.82	
1663	11/19/92	1	3.26	10.07	0.51	11,876	0.87	
	11/19/92		2.95	10.04	0.51	11,704	0.87	
1699	11/24/92	1	1.70	9.76	0.58	11,939	0.97	
1698	11/24/92	1	2.16	9.68	0.59	11,830	1.00	80 mesh repeater.
	11/24/92		1.68	8.77	0.58	11,838	0.84	
1690	11/25/92	1	1.88	8.89	0.54	11,878	0.91	
	11/25/92		1.48	9.78	0.55	11,863	0.92	
1694	11/26/92	1	2.05	9.71	0.58	11,855	0.84	
	11/26/92		2.01	9.81	0.55	11,838	0.93	
1692	11/27/92	1	2.10	9.68	0.53	11,867	0.89	
	11/27/92		1.95	9.81	0.51	11,870	0.88	
1693	11/28/92	1	2.37	9.82	0.52	11,849	0.88	
	11/28/92		2.30	9.77	0.52	11,836	0.88	
1697	11/29/92	1	2.15	10.17	0.67	11,830	1.13	
	11/29/92		1.97	10.12	0.82	11,869	1.04	
1712	11/30/92	1	2.56	9.83	0.82	11,814	1.05	
	11/30/92		2.30	10.03	0.60	11,842	1.01	
1733	12/09/92	1	1.88	9.58	0.52	11,943	0.87	
	12/09/92		1.73	9.53	0.52	11,950	0.87	
1736	12/10/92	1	2.14	9.47	0.59	11,915	0.99	Sample #2
1737	12/10/92	1	2.23	9.22	0.53	11,900	0.89	80 mesh repeater.
1737	12/10/92	1	2.01	9.25	0.53	11,968	0.88	Sample #1
	12/10/92		1.83	9.32	0.49	11,868	0.82	
	12/10/92		1.90	9.63	0.58	11,932	0.97	
1744	12/11/92	1	2.23	9.45	0.57	11,939	0.95	
	12/11/92		1.99	9.45	0.57	11,934	0.96	
			2.07	9.51	0.53	11,907	0.88	
AVERAGE			0.35	0.38	0.05	74	0.09	
STANDARD DEVIATION			1.17	8.80	0.44	11,876	0.74	
MIN			3.26	10.17	0.67	12,116	1.13	
MAX								

5.0 PROBLEM AREAS AND LESSONS LEARNED

Three major problem areas that are being addressed concurrently include:

Facility Reliability

Process gas leaks have proven to limit the facility's availability. The second-stage drying gas loop has been the most difficult to seal. Problems in containing the superheated gases in the second stage have been exacerbated in two cases where seal compression force was limited. The explosion relief panels were sealed using preload force from the same break-way clips that supply the predictable explosion relief pressure. The second location with limited seal force is the second-stage dryer hoods. The original hood design was inadequate to contain any significant positive pressure. Both areas are still causing periodic problems, but a combination of modifying the equipment, substituting gasket materials, and improving installation techniques has minimized the leakages.

Dust handling has also proven to be a major problem. The main components used in transporting the process fines are tubular drag conveyors, which have not performed up to expectations. The conveyors are unable to convey full-rated flow and have exhibited significant wear after relatively short operating times. These tubular drag conveyors are the facility's throughput bottleneck and the most frequent cause of unplanned shutdowns. Troubleshooting efforts have been aimed at improving the reliability of the existing equipment. A new fines conveying, disposal, cooling, and loadout system design effort was initiated. To continue process testing and improve reliability in light of the fines conveying bottleneck, the plant was converted to a single train operation in November.

Product Stability

The dried, cooled, and cleaned coal produced to date has exhibited spontaneous heating and combustion. When any significant mass of coal (more than 1 to 2 tons) is exposed to any significant air flow for periods ranging from 18 to 72 hours, the coal reaches temperatures necessary for spontaneous combustion or auto ignition to occur. Spontaneous heating of run-of-mine, low-rank coals has been a common problem but usually occurs after open air exposure periods of days or weeks, not hours. However, dried, low-rank coals have universally displayed spontaneous heating tendencies to a greater degree than raw, low-rank coals.

Troubleshooting this problem consisted primarily of testing process modifications, testing the application of additives to the coal both during and after the process, and considering additional process steps.

Product Dustiness

The product is basically dust free when it exits the processing facility due to numerous steps where the coal is fluidized in process gas or air, which removes the dust-size particles. The gas and air entrains any dust that has been produced since the last process step.

Typical to coal handling systems, each handling activity performed on the product coal after the coal leaves the process degrades the coal size and produces some dust. The fall into the product silos, which can be up to 90 feet, can be especially degrading to the coal. Quantifying dustiness of coals is difficult, but once the product coal has passed through the nine transfer points between the process and a rail car, the coal is visibly dustier than run-of-mine coal. The SynCoal® product is actually no dustier than the raw coal; the dust is just more fugitive. Because the SynCoal® product is dry, it does not have any inherent ability to adhere small particles to the coal surfaces. This allows any dust-size particles that are generated by handling to be released and become fugitive.

Troubleshooting efforts on this problem have just begun. These efforts consist of modifying transfer points to reduce impacts, examining methods of reducing degradation in the silos, and examining dust suppression options.

6.0 FUTURE WORK AREAS

Work continues on improving plant reliability and product stability. Once stable and maintainable systems have been obtained and the product is adequate for shipping, bulk production to produce test burn quantities will be the primary facility goal while continuing process testing and optimization.

APPENDIX A

Significant Accomplishments from Origination of Project to Date

SIGNIFICANT ACCOMPLISHMENTS (SINCE CONCEPT INCEPTION)

September	1981	Western Energy contracts Mountain States Energy to review LRC upgrading concept called the Greene process.
June	1982	Mountain States Energy built and tested a small batch processor in Butte, Montana.
December	1984	Initial patent application filed for the Greene process, December 1984.
November	1984	Initial operation of a 150 lb/hr continuous pilot plant modeling the Greene drying process at Montana Tech's Mineral Research Center in Butte, Montana.
November	1985	Added product cooling and cleaning capability to the pilot plant.
January	1986	Initiated process engineering for a demonstration-size Advanced Coal Conversion Process (ACCP) facility.
October	1986	Completed six month continuous operating test at the pilot plant with over 3,000 operating hours producing approximately 200 tons of SynCoal®.
October	1986	Western Energy submitted a Clean Coal I proposal to DOE for the ACCP Demonstration Project in Colstrip, Montana, October 18, 1986.
December	1986	Western Energy's Clean Coal proposal identified as an alternate selection by DOE.
February	1988	First U.S. patent issued February 16, 1988, No. 4, 725,337.
November	1987	Internal Revenue Service issued a private letter ruling designating the ACCP product as a "qualified fuel" under Section 29 of the IRS code, November 6, 1987.
May	1988	Western Energy submitted an updated proposal to DOE in response to the Clean Coal II solicitation, May 23, 1988.
May	1989	Second U.S. patent issued March 7, 1989, No. 4, 810,258.

**SIGNIFICANT ACCOMPLISHMENTS (cont'd.)
(SINCE CONCEPT INCEPTION)**

December	1988	Western Energy was selected by DOE to negotiate a Cooperative Agreement under the Clean Coal I program.
June	1990	Reach a negotiated agreement with DOE on the Cooperative Agreement, June 13, 1990.
September	1990	Signed Cooperative Agreement, after Congressional approval, September 13, 1990.
September	1990	Contracted project engineering with Stone & Webster Engineering Corporation, September 17, 1990.
December	1990	Formed Rosebud SynCoal Partnership, December 5, 1990.
December	1990	Started construction on the Colstrip site.
March	1991	Novated the Cooperative Agreement to the Rosebud SynCoal Partnership, March 25, 1991.
March	1991	Formal ground breaking ceremony in Colstrip, Montana, March 28, 1991.
December	1991	Initiated commissioning of the ACCP Demonstration Facility.
April	1992	Completed construction of the ACCP Demonstration Facility and entered Phase III, Demonstration Operation.
June	1992	Formal dedication ceremony for the ACCP Demonstration Project in Colstrip, Montana, June 25, 1992.
August	1992	Successfully tested product handling by shipping 40 tons of SynCoal® product to MPC's Colstrip Project, Unit 3 by truck.
October	1992	Completed 81 hour continuous coal run 10/2/92.
November	1992	Converted to a single process train operation.
December	1992	Produced a passivated product with a two-week storage life.